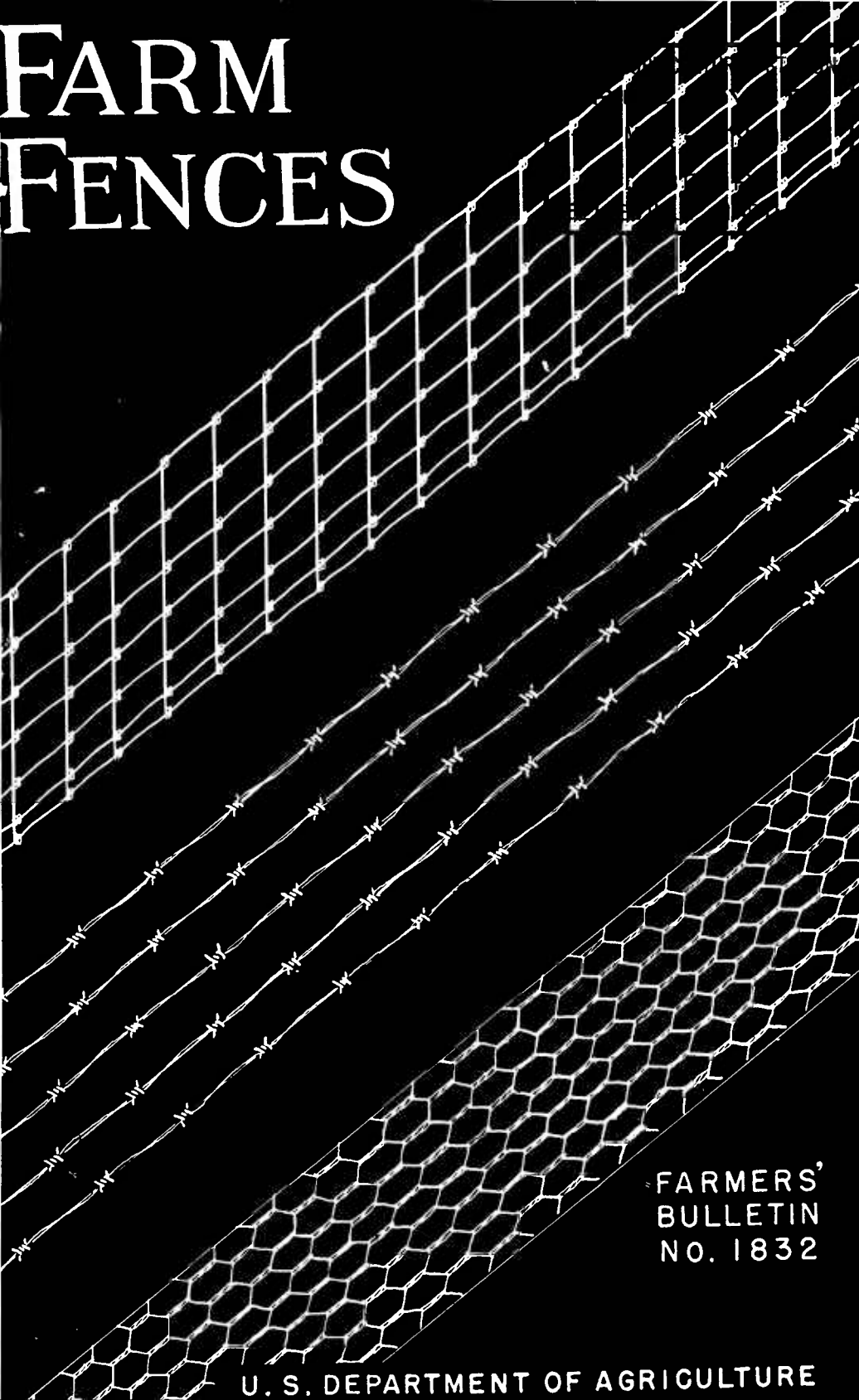
FARM FENCES



FARMERS' BULLETIN NO. 1832

U. S. DEPARTMENT OF AGRICULTURE

A GOOD FARM FENCE adds greatly to the attractiveness of a farmstead, is a mark of thrift, and is an important item in farm management since fences may be used to protect farm properties and reduce losses of both crops and livestock.

Made mostly of rails, boards, stone, or hedge a hundred years ago, farm fences are now largely of barbed or woven wire, but the old-time materials are still in use. There are steel posts and posts of concrete, and new treatments are making wood posts more durable and making possible the use of different kinds of woods.

Lately the electric fence has aroused interest in many parts of the country, but the safety factors have not been thoroughly worked out and standardized, a fact that makes it doubly important for farmers to acquaint themselves with their own State recommendations and to observe precautions.

Fast-moving motor traffic has introduced new hazards for those using farmstead and field entrances, and designs for approaches are being changed in consequence. Motor vehicles and tractors have also created a greater demand for automatic gates and livestock guards.

Washington, D. C. Issued January, 1940

FARM FENCES

By M. A. R. KELLEY, *agricultural engineer, Division of Structures, Bureau of Agricultural Chemistry and Engineering*

CONTENTS

INTRODUCTION

FENCES have grown up with the country. Changes in the material used in their construction coincide with industrial developments and with the spread of agriculture to regions varying in natural resources and conditions. Colonial farmers fenced with stone walls when they needed a convenient place to pile the stone removed from fields, or they used rails and sometimes the uprooted stumps of trees piled in a tangled row. Hedges were used rather early, and George Washington's interest in them as a means of stopping breachy cattle led him to import seedlings and to try out several promising shrubs and trees.

The invention of machinery for the manufacture of wire at low cost greatly increased the use of barbed-wire and woven-wire fences. In 1874, 5 tons or 10 miles, of barbed wire were manufactured. Ten years later the quantity had increased to 62,500 tons, or 250,000 miles. In 1935, 51 years later, according to United States census, 195,996 tons of barbed wire, valued at $10,772,272 was manufactured; 33,992 tons of poultry netting, valued at $3,868,750; and 229,137 tons of woven wire, valued at $17,338,853. The earlier wire weighed approximately 1,000 pounds per mile, whereas that now made weighs 400 pounds. The heavier wire probably had longer life, but it also cost more than the light wire now sold. In the early days, the cost of fencing was almost prohibitive, often more than the lands or cattle were worth; hence cowboys or shepherds tended the herds or flocks. Cheapening the cost of production and improving the designs have made simple fencing generally available.

A well-built fence is good insurance against lawsuits and promotes good relationship between neighbors by avoiding petty annoyances.

The laws of most States define what constitutes a legal partition fence, a fence along a highway, or adjacent to a railway. However, no general laws are in effect, and local sources must be consulted.

Midwestern States, because of the large areas requiring fencing, are inclined to be liberal but in most cases hold the owner liable for any damage done by his livestock. The motorist in the Southern States is well advised to avoid the killing of livestock on highways both because of risk to his own property and life and also because of the high cost of damage suits. Livestock on the arterial highways are all too common and are always a menace, but laws relating thereto vary considerably in the different States.

In certain areas where little livestock is kept, fences along highways are omitted and crops are grown up to the right-of-way.

Serious problems are introduced by high-speed traffic on highways. Although paved highways are very helpful in hauling crops to market, the farmer finds it increasingly difficult to provide safe entrance or exit from fields along the highway. To reduce these risks he must carefully select the locations of exits and often make lanes to and from the pastures.

The area of land occupied by fences is an important factor in the selection of the type of fencing, particularly if the land is of high value. In marginal, cut-over, and low-priced land, the unit cost of fencing is of more importance than the type. The amount of land used by fences varies with the type of fence, size of field, and kind of crop grown. Cultivated row crops require wider strips for turning implements than do hay or grain crops, since a mower or binder can cut close to the fence line. Little land is wasted where pasture or orchards are divided by wire fences. Woven-wire or smooth-wire fences require less turning space than barbed wire, while stone, hedge, and rail fences require strips varying from 6 to 10 feet or more. A surprising amount of hedge fence is still used notwithstanding the wide strips of land they render unfit for crops. Hedge, stone, and rail fences have high maintenance cost for trimming and for clearing of brush and weeds.

KINDS OF FENCES

RAIL FENCES

The zigzag, worm, or Virginia rail fence, as it is variously named, is found in most States east of the Missouri River and in some of the Western States. When well-built on a solid footing, it is substantial, and where labor and wood are plentiful it makes a cheap fence. It is useful as a temporary fence since it may be moved as the fields are cleared or extended.

The stability of a rail fence depends on the manner of bracing. Figure 1 shows different types of rail fences. The zigzag type, *A* and *B*, are the most common in southern areas. They are built 6 to 11 rails high with two braces or stakes either in the angles or corners. The rails are usually 11 feet long and are laid at an angle which advances the fence 8 feet. A width of base of 4½ to 5 feet is necessary to withstand high winds. The heaviest rails are placed on top to give added weight and decrease breakage from climbing the fence.

Stakes are also used with straight rail fences (fig. 1, *C*). The stakes are tied together with wire, usually in three places. The fence

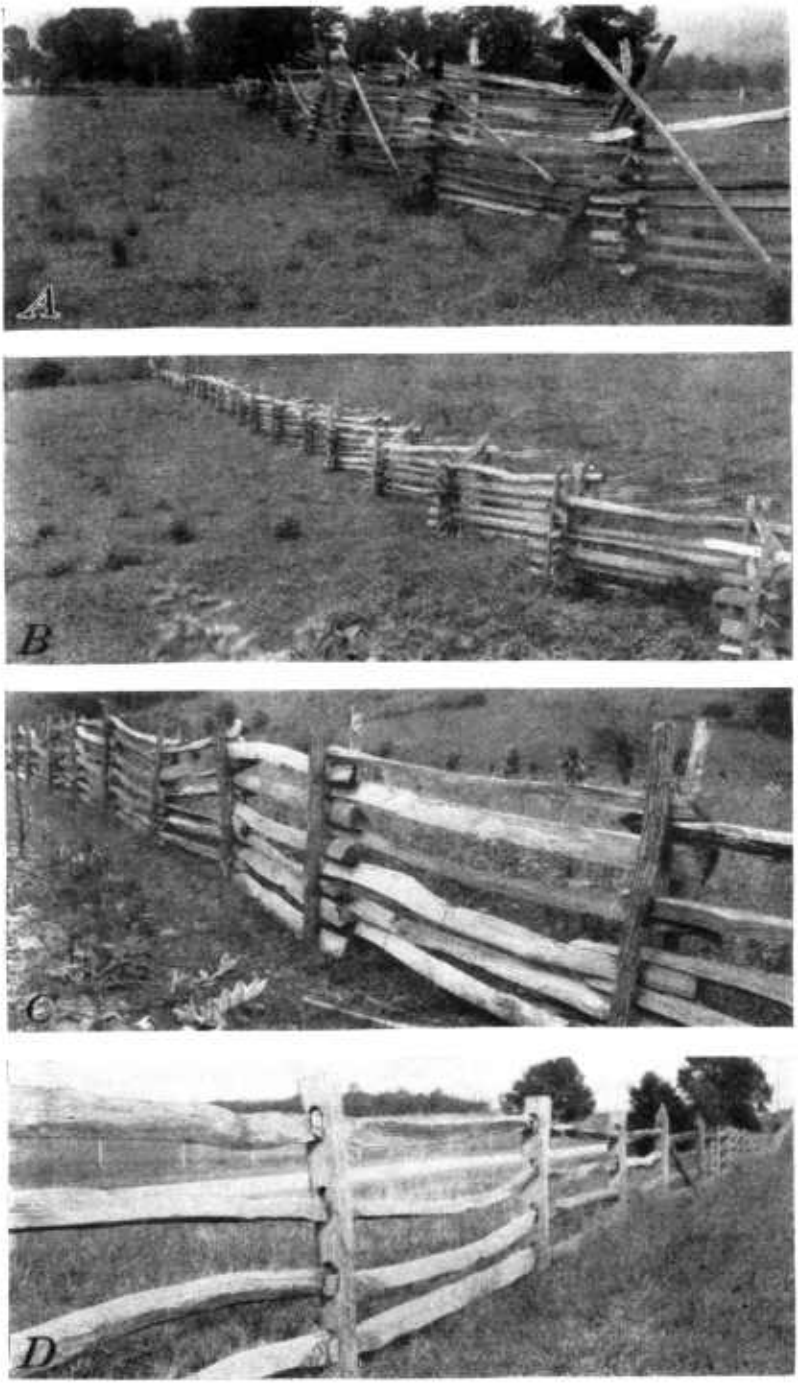


FIGURE 1.—*A*, A high zigzag rail fence having 11 rails and braces in the angle; *B*, a rail fence of average height with stakes in the corners; *C*, a straight rail fence with stakes driven and wired together; *D*, chestnut rails in mortised posts.

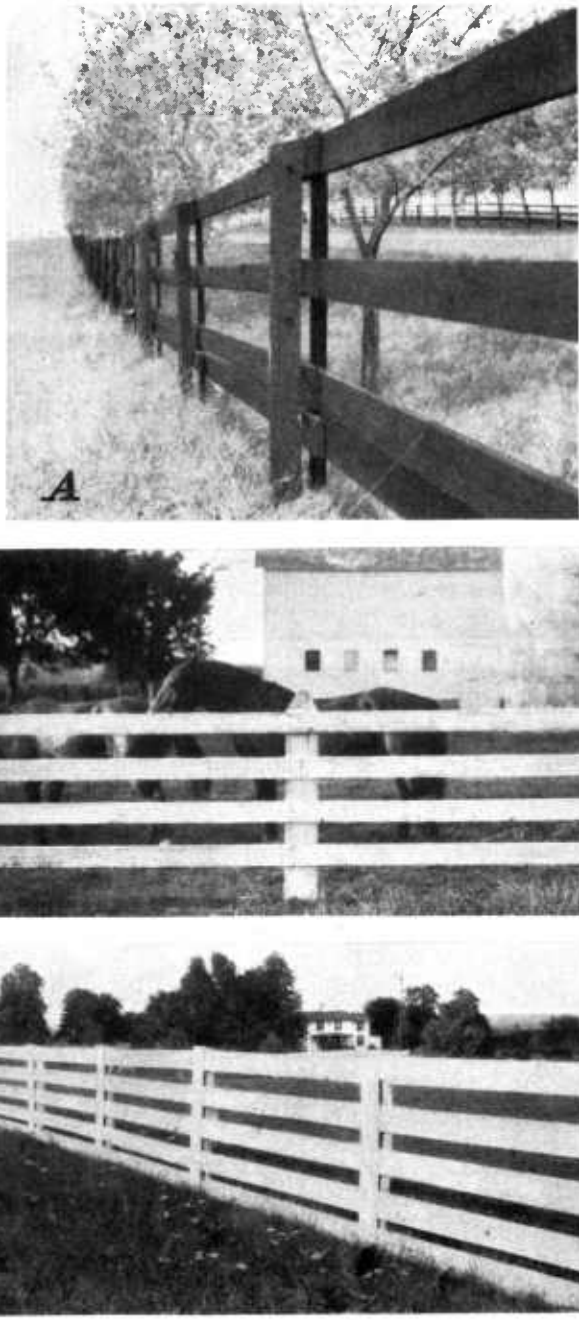


FIGURE 2.—*A*, A board fence and posts treated with creosote—boards are removable; *B*, a substantial plank fence around a barn lot. Note the joints on alternate posts; *C*, a common design for a five-board fence with cleat boards and post caps.

line in this case requires fewer rails per mile and is easier to keep clean, and less ground is wasted than with the zigzag form. Figure 1, *D*, shows another form of straight rail fence with mortised wood posts. Concrete posts are sometimes used.

BOARD FENCES

Many board fences are found in Virginia and Kentucky, particularly where horses are raised extensively. When painted white or whitewashed, such fences make an attractive framing for a farmstead. Painting adds to the cost of maintaining them.[1] The boards and posts are sometimes creosoted; this increases their durability but gives the fence a less attractive appearance. A special cleat having bored holes through which sixtypenny spikes are driven to clamp and support the boards is shown in figure 2, *A*. In case of fire or for other reasons, the cleats may be easily loosened and the boards removed. The use and position of the double board at the bottom lessens the danger of injuries to horses' legs.

When planks are used, three to six planks are well spiked or bolted to a substantial post to form a safe fence for a paddock or barn lot (fig. 2, *B*). Planks should be on the paddock side of the post to prevent loosening by stock crowding against the fence. One-inch boards 6 or 8 inches wide are nailed on with tenpenny galvanized or cut nails, which last longer than common wire nails and are less likely to split the board. Four to six boards are commonly used in a single panel. With the lighter boards, cleats and post caps are often used (fig. 2, *C*). For paddocks a cap board extending from post to post is sometimes used.

STONE FENCES

Stone fences are as varied as the kinds of stone available for their construction. In portions of the Atlantic Coast States more than 30 percent of the fences are of stone. Stone fences harbor vermin and pests and are difficult to keep free from trash, brush, and weeds. They vary in height from 3½ to 5 feet depending upon the livestock confined. They should be built on a substantial and well-drained foundation. Stone fences are made with loose flat, or quarried stone or field boulders. To lay a loose stone fence and to properly tie and chink the large stones with smaller ones requires some skill. Stone fences may be made with full mortar joints or occasional mortar ties. Various styles of construction are shown in figure 3.

BARBED-WIRE AND WOVEN-WIRE FENCES

The two most important types of farm fences are barbed wire and woven wire. Barbed-wire fences are especially useful in areas where stone and timber are scarce. A survey made in Illinois in 1929 revealed that barbed wire constituted 61 percent of the fences on grain farms, 77 percent on general farms, and 79 percent on dairy farms, while on hog farms 52 percent of the fences contained some woven wire in their construction (see table 9, p. 31). Barbed wire predominates in most livestock areas.

[1] See Farmers' Bulletin 1452, Painting on the Farm.

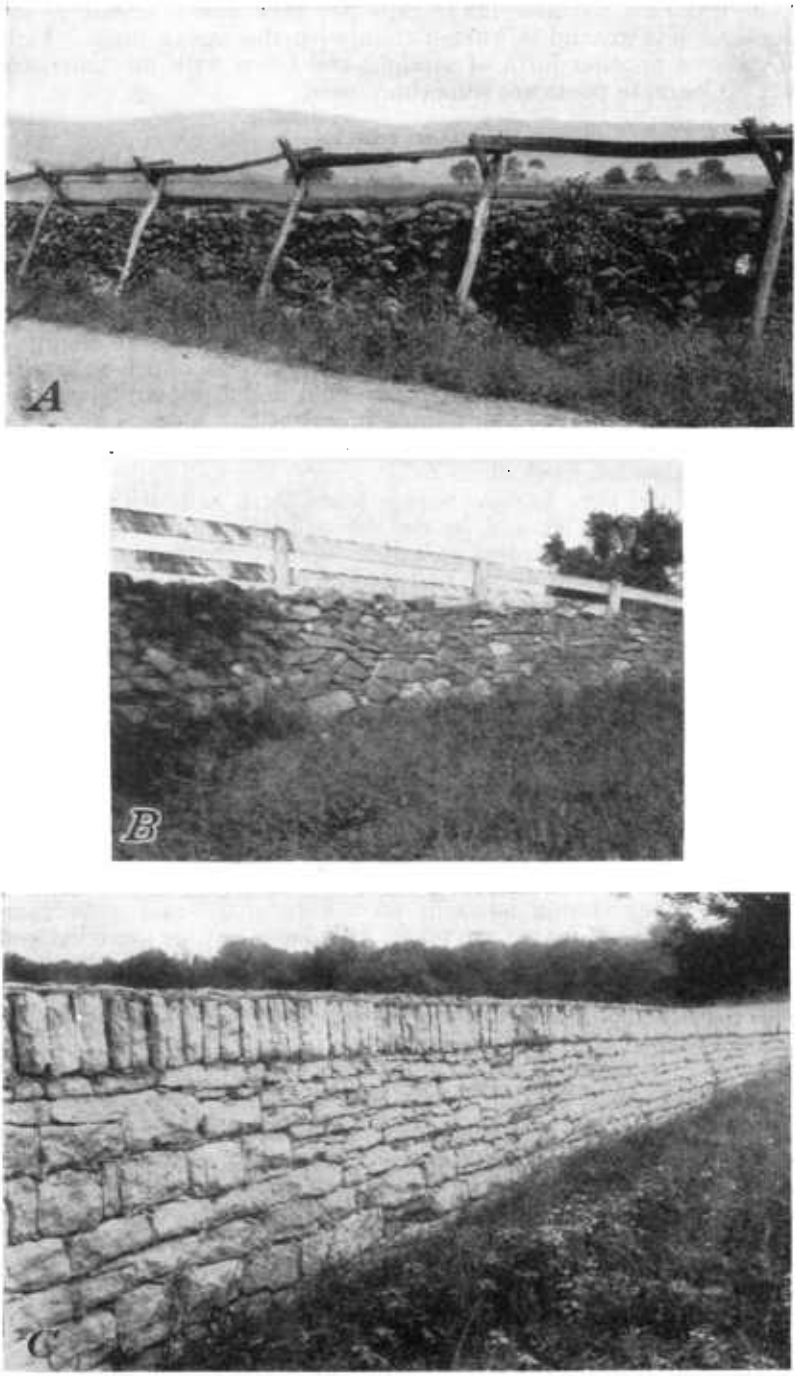


FIGURE 3.—*A*, A Virginia fence of loose stones with stakes and riders to increase height; *B*, a combination board and loose stone fence; *C*, a fence of limestone with an occasional mortar tie and a top dressing.

BARBED WIRE

There are seven principal styles of barbed wire. Standard gage of wire strands are 12 and 12½ with a 14-gage wire for the barbs. Some manufacturers also make a two- and four-point light-gage wire with strands of No. 14 wire. In table 1 it is noted that barbed wire is made with both two and four points spaced 3 or 4 inches apart for hog wire and 5 or 6 inches for cattle wire. Flat barbs usually are obtainable only in two-point form. Short- and long-point barbs are available to a limited extent. The styles shown in table 1 seem ample to meet all ordinary needs of the farm, and it appears likely that the number of these styles will be reduced in the future. Flat ribbon wire is used for horse enclosures and by some railroads. Table 2 gives data regarding various sizes of wire used for fences.

TABLE 1.—*Specifications of barbed wire commonly used for farm fencing*

Barbs			Wire gage		Barbs			Wire gage	
Points (number)	Shape	Spacing	Strand	Barbs	Points (number)	Shape	Spacing	Strand	Barbs
		Inches	*No.*	*No.*			*Inches*	*No.*	*No.*
2	Round	3 (hog), 5 (cattle)	12	[1] 14	2	Half round	3 (hog), 5 (cattle)	12½	14
		3 (hog), 5 (cattle)	12½		4	do	3 (hog), 6 (cattle)	12½	14
4	do	4 (hog), 6 (cattle)	12	[1] 13	2	Round	3 (hog), 5 (cattle)	14	[2] 16
		4 (hog), 6 (cattle)	12½		4	do	3 (hog), 5 (cattle)		
2	do	3 (hog), 5 (cattle)	12½	14	No barbs	2 strands, twisted.		12, 12½	
2	Flat	3 (hog), 5 (cattle)	12½	14					

[1] Styles shown in these groups meet Federal Standard Specifications RR-F-221, adopted May 1934.
[2] Provides lighter than standard weight for special uses.

TABLE 2.—*Sizes and weights of wire commonly used in farm fencing*

Gage No.	Diameter	Surface area per pound	Weight per 100 feet	Length per pound	Weight per—	
					Mile	Rod
	Inches	*Square feet*	*Pounds*	*Feet*	*Pounds*	*Pounds*
9	0.1483	0.66	5.87	17.05	309.7	0.97
10	.1350	.73	4.86	20.57	256.7	.80
11	.1205	.82	3.87	25.82	204.5	.64
12	.1055	.93	2.97	33.69	156.7	.49
12½	.0990	.98	2.64	37.82	139.4	.43
13	.0915	1.08	2.23	44.78	117.9	.37
14	.0800	1.23	1.70	58.58	90.1	.28
14½	.0760	1.29	1.54	64.93	81.3	.25
19	.0410	28.7	.44	223.00	23.7	.07
20	.0348	33.8	.32	309.60	17.0	.05

In southern areas barbed wire is objectionable because of the screwworm fly, which lays its eggs in open wounds.

Barbed wire, in the past, was sold in spools either of 80 rods or 100 pounds of wire, but the 100-pound spool as a standard has now (January 1, 1938) been discontinued by wire manufacturers. In comparing quality and prices, weight is important, but the farmer wants to know

the length of fence he can build. Hence all spools should have tags showing length as well as weight. An 80-rod spool of barbed wire weighs approximately 74 to 76 pounds.

Figure 4,*A*, illustrates a well-built barbed-wire fence with five lines, while figure 4,*B*, shows a four-line barbed-wire fence which is

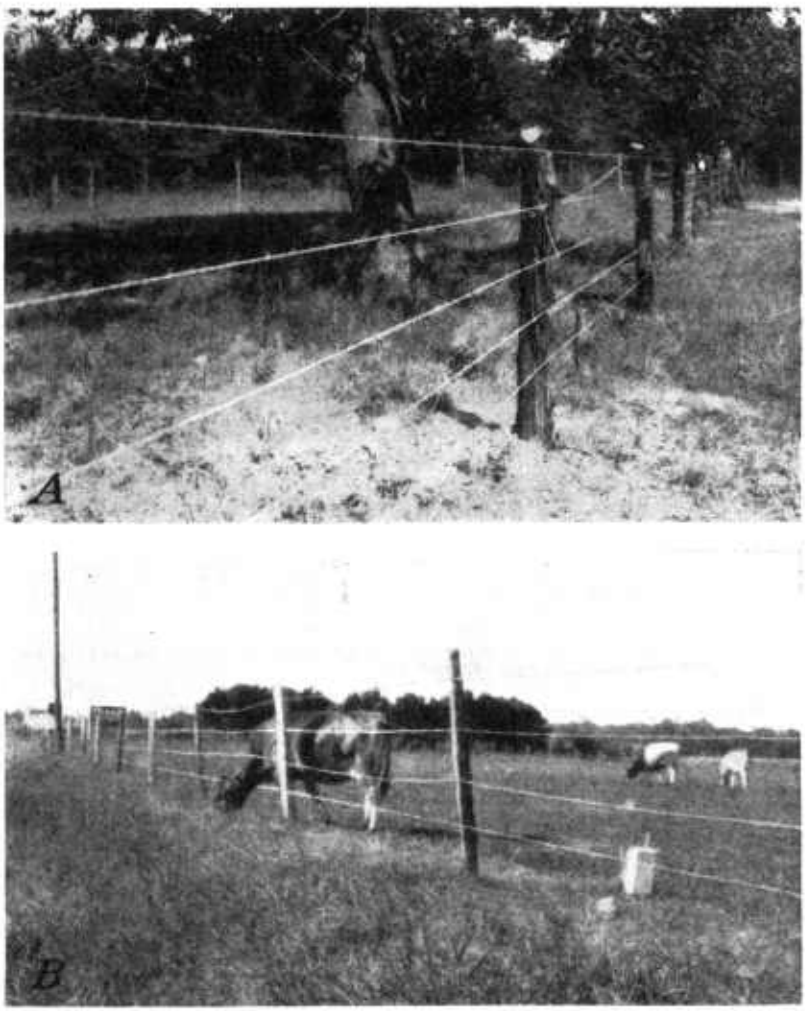


FIGURE 4.—*A*, A well-built five-line barbed-wire fence on cedar posts, suitable for cattle; *B*, many four-line barbed-wire fences are badly stretched by stock reaching through and require frequent repair.

continually strained and requires restapling and restretching at frequent intervals.

WOVEN WIRE

The first woven-wire fencing was made in the early eighties. Then followed a period when line wires were stretched on posts and properly spaced, and the stays woven in by hand-cranked apparatus with

spools of wire which revolved about these line wires. Now most woven wire is factory-made. For field fences the rectangular (fig. 5) or diamond mesh (fig. 14) are most common. Single and double loop, full or half hexagon, or slight variations are used for paddocks, lawns, gardens, and poultry yards. The close-mesh rectangular, diamond, or chain link are used for nonclimbable guard fences and for lawns. Standard heights for poultry nettings range from 12 to 72 inches for the lighter specifications and for the heavier from 26 to 55 inches.

To reduce the number of styles and the cost of production and sales, the United States Department of Commerce in 1924 promulgated,

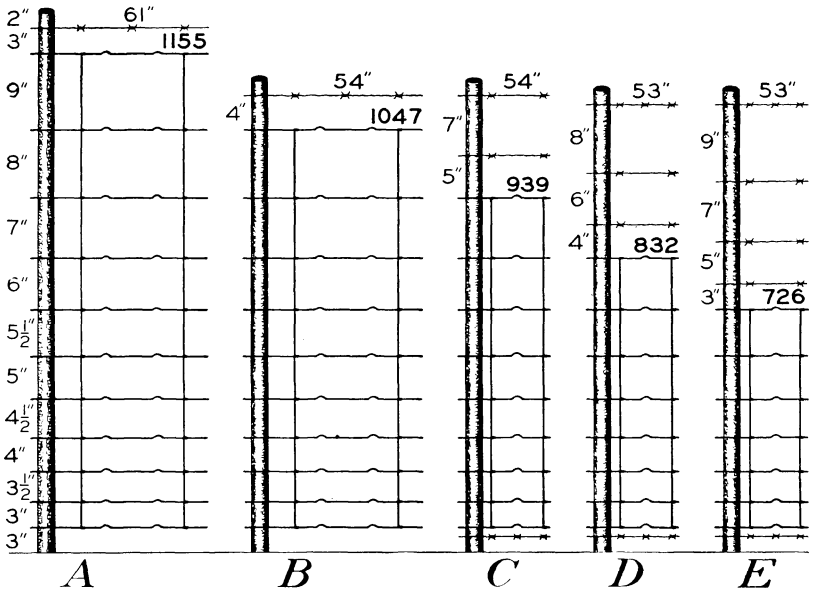


FIGURE 5.—Simplified-practice standards in woven-wire fencing combined with barbed wire for good construction of farm fences: *A*, Fence with a single top line of barbed wire and wide-width woven fencing of 55 inches, 11 bars, and 12-inch spacing of stays; *B*, similar to *A* except for 47-inch width of woven fencing: *C*, *D*, and *E*, also show variations in width and number of lines of barbed wire with 6-inch spacing of stays. Bottom line of barbed wire used for hogs.

in cooperation with fence manufacturers, Simplified-Practice Recommendations No. 9. The standard styles commonly used on farms (fig. 5) are numbered 1155, 1047, 939, 832, and 726. Special styles sometimes are made in sizes 958, 849, and 741. The first one or two digits represent the number of line wires and the last two the height in inches; i. e., 1155 has 11 horizontal wires and is 55 inches in height. In standard fencing the vertical stay wires are spaced 6 or 12 inches. Cheap fencing sometimes has wider spacings and smaller wire. This fact should be remembered in comparing the prices of fencing.

Full-gage Nos. 9, 11, 12½, and 14½ are used for standard livestock fencing and 13 and 14½ for poultry and garden fences. Standard specifications are designated in accordance with the size of the stay wire used, as shown in table 3. For extra-heavy wire, specification No. 7 is used. However, the specifications given in the table meet

all ordinary requirements on the farm. The heavier wire gives longer service and lowers the annual cost of maintenance. As shown by table 2, the smaller wire has greater surface area per pound of wire and hence is more subject to damage from corrosion.

TABLE 3.—*Standard specifications for woven-wire fences*

Item	Wire-gage Nos. used for Specification No.—				Item	Wire-gage Nos. used for Specification No.—			
	9	11	12½	14½		9	11	12½	14½
Top bar	9	9	10	11	Intermediates	9	11	12½	14½
Bottom bar	9	9	10	11	Stays	9	11	12½	14½

Stay wires are made stiff or flexible, and either form may be had from most manufacturers. The flexible stay is said to absorb shocks more readily while the stiff stay (fig. 23) tends to keep the fence more erect. The advantages of these characteristics are limited by the quality of wire and the workmanship used.

Another feature of a good woven wire is that of tension curves. These curves are built into the line wires for the purpose of providing for contraction and expansion due to temperature changes. These curves are in some cases offset as much as three-eighths of an inch with a spacing every 6 inches (fig. 5). In stretching the fence they serve as a guide with respect to the amount of wire tension applied during erection. This is discussed on page 43. If the wire is of high quality and not excessively stretched it is elastic enough to expand and contract with temperature changes without becoming permanently elongated.

Figure 6 illustrates a well-built woven-wire fence; figure 7 shows how the fence may be crowded down by stock when the top strand of barbed wire is omitted.

CORROSION OF WIRE

All iron rusts in moist air unless protected. Early manufacturers used red paint or lacquer to prevent corrosion, but now galvanizing (coating with zinc) is the principal protection used. Good zinc is one of the best coatings known, and new methods of application are being constantly devised.

Small electric currents flow whenever two dissimilar metals such as iron and zinc or two pieces of iron of different composition are wetted by a salt solution. This is called electrolysis. All rain water contains some salts, and that near the seacoast has heavier concentration than that inland. Water collected during a thunderstorm is rich in salts that induce electrolysis. It is thought that weeds and grasses tend to ground these charges and to neutralize their oxidizing or corrosive effects. This may explain the principal action but does not provide a measure of why some wires rust faster than others. The presence of salts suggests a reason for the shorter life of wire fencing near the seacoast.

POULTRY FENCING

The first step in successful poultry raising is sanitation. Good fencing is of prime importance in the maintenance of sanitary condi-

tions about pens and house. Separation of diseased stock, breeding stock, chicks from older birds, and pullets from hens usually can be secured by poultry fencing. Wire cloth or netting is used for sun parlors, floors, and roosts.

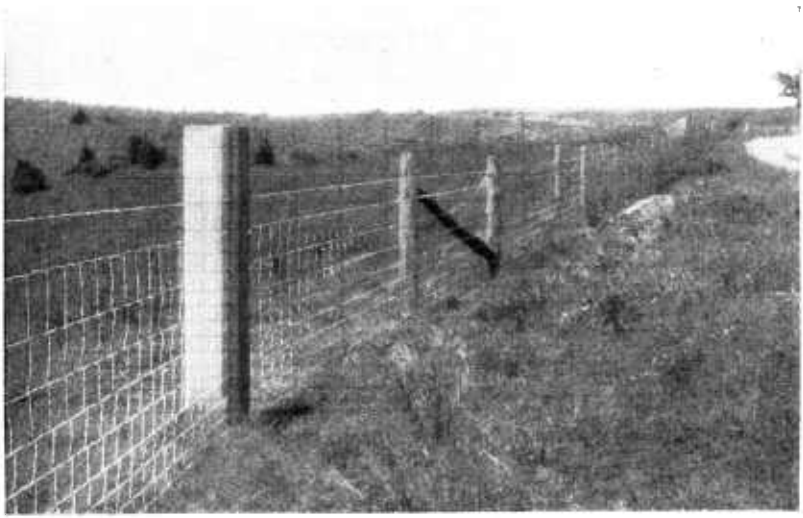


FIGURE 6.—A well-built woven-wire fence, showing line brace and concrete anchor post with cleat board to retain fence line on curve.

FIGURE 7.—Top line of barbed wire omitted; result—fence crowded down by livestock.

The Department of Commerce standards for poultry fencing provided principally for fences of sufficient strength to resist stock and are made in specification 13 and 14½ with 6-inch spacing of stays.

and in three height specifications, Nos. 2158, 1948, and 1635 (fig. 8), There are no other set standards for poultry fencing and netting.

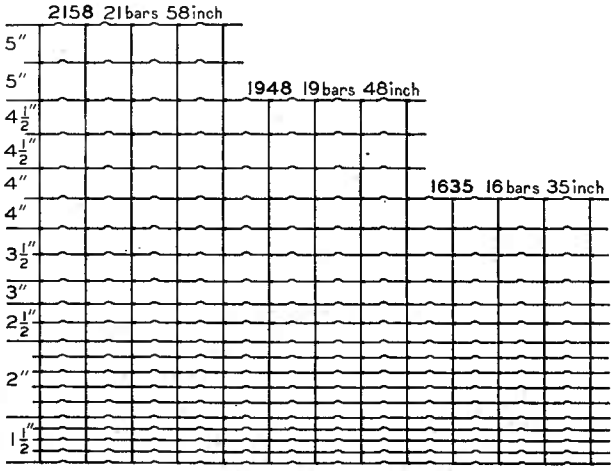


FIGURE 8.—Common forms of woven fencing showing spacing commonly used for poultry.

The kinds of poultry fencing shown in one catalog would require the dealer to carry more than 70 different rolls of the fencing. Rolls are usually 150 feet long, but some are 10 or 20 rods long. There appears

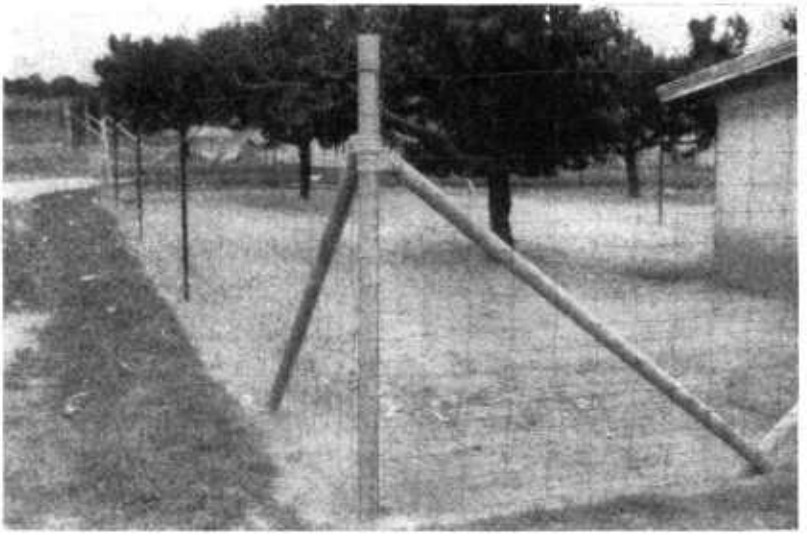


FIGURE 9.—Poultry fence showing a well-braced steel corner post. The fence needs to be restretched.

to be no need for such a large number of variations. Simplification of poultry-fence styles would in the long run result in lower prices to the consumer.

Heavy poultry fencing may be obtained in heights of 36, 48, 60, and 72 inches and poultry netting in heights of 12, 18, 24, 30, 36, 42, 48, 60, and 72 inches. Poultry fencing with stays spaced 3, 4, or 6 inches are available. Where small chicks are to be confined, the first six bars from the bottom vary from 1 inch apart to 1½ and 1¾ inches apart, the space gradually increasing with the height (fig. 8).

The height of fencing for heavy breeds may be 48 or 60 inches, but for the lighter breeds a height of 72 inches is preferable. A single wire on a bracket facing the pen side placed above the wire netting is effective in discouraging birds from flying out of the pen.

Figure 9 shows a poultry-yard fence with a well-braced corner.

For small poultry yards and small back yards, poultry netting serves for a short time, but the poultry specialist will find that wire

FIGURE 10.—A movable fence on steel post useful in hogging down corn.

fencing with heavier specification will have a longer life and give more satisfactory service.

ADAPTING WIRE FENCES TO SPECIAL NEEDS

The choice of a fence is determined by the type of farming and size of farm. Horses, cattle, hogs, sheep, and poultry are found in all parts of the United States, but the relative importance of each class of animal varies. In the Corn Belt, horses, cattle, sheep, and hogs may at times be found together in the same pasture or in adjacent fields. Hence a high woven-wire fence such as that shown in figure 5, *A* and *B*, is commonly found in this area. The narrow woven-wire fence is also common; the 26-inch fence with three barbed wires above, or a 32-inch fence with two strings of barbed wire (fig. 5, *D* and *E*) may be used. Either is satisfactory for hogs and sheep. Barbed wire alone, because it tears the fleece, is less suitable for sheep, particularly in small lots or pastures.

Since the purpose of the top string of barbed wire is to prevent stock from crowding down the fence, a string of barbed wire with points spaced 3 or 4 inches apart should be used on top of woven wire, as shown in figure 6. A barbed wire 2 or 3 inches above the ground is used for hog fences in permanent pastures to discourage rooting. A

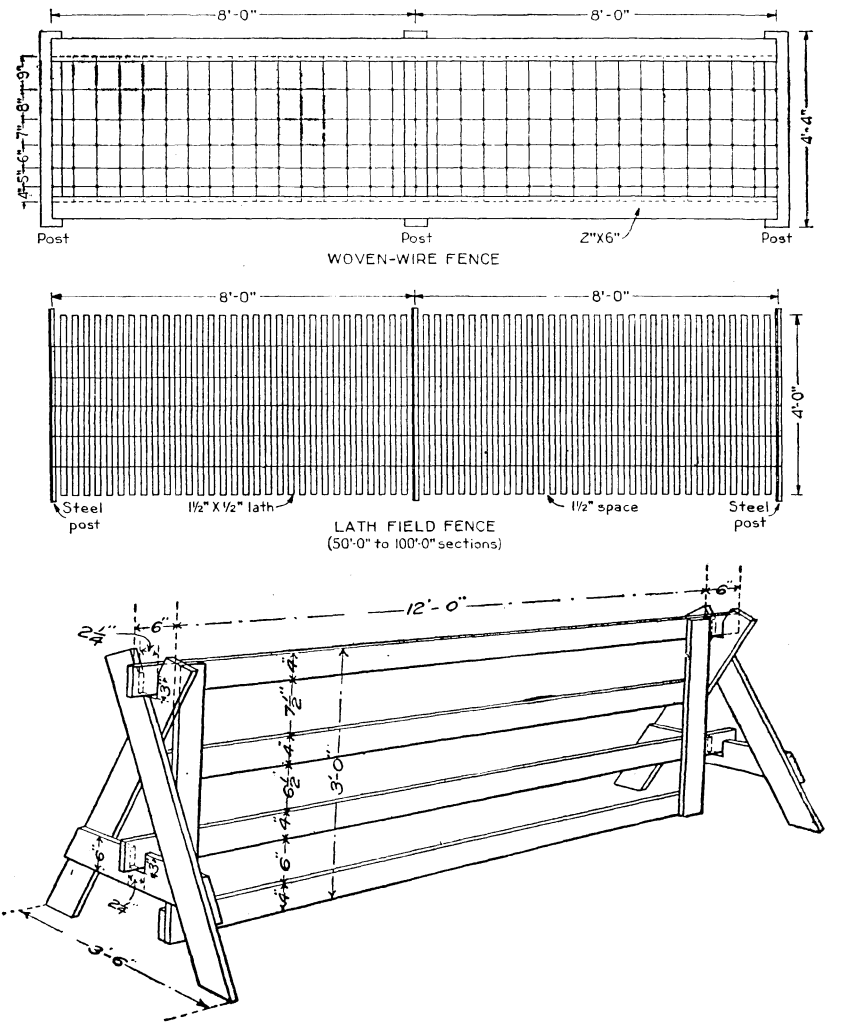


FIGURE 11.—Three economical types of sheep fences: Upper, combination wire and boards; middle, a movable slat or snow fence; lower, a portable fence useful for pasture and soiling crops and temporary lots.

common practice in the Corn Belt is that of hogging down corn. For this purpose a temporary fence such as that shown in figure 10 is often used. To secure a hog-tight fence with barbed wire alone requires six strings of wire, which often costs more to build and maintain than does a woven-wire fence. Barbed wire with four points and 3-inch spacing is designed principally for hogs (fig. 5).

Forms *C* to *E* (fig. 5) are commonly used for hogs. The 26-inch woven wire is preferable when used for temporary hog fence in a cornfield (fig. 10), since it may be easily rolled between corn rows. There is little difference in cost of construction between form *D*, having three lines of barbed wire, and form *E*, having four lines, and the cost of upkeep of the former is less.

In the Western States large permanent pastures are fenced with but three strands of barbed wire, and in some sections of low-priced land two strands are used to hold cattle on a given area. Such fences do not restrain all individuals, and those with "fence-busting" propensities should be provided with yokes or other devices for keeping within bounds.

If fences are not used, sheep must be carefully herded, which often involves considerable expense. In many cases it is possible to use

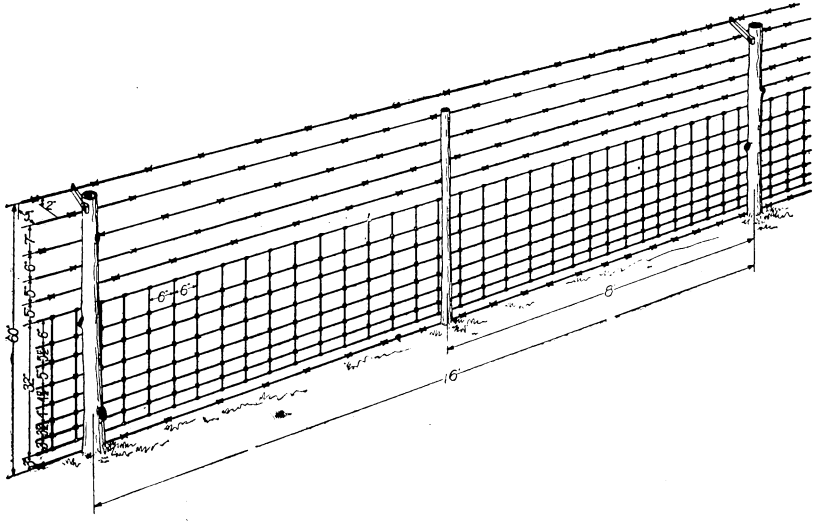


FIGURE 12.—A dog- or coyote-proof fence used in range-sheep production.

temporary fences (fig. 11, *B* and *C*). In constructing such fences fewer posts are required for sheep than for hogs.

Sometimes it is worth while to build fences for protection against coyotes and dogs (fig. 12), which sometimes cause large losses as is revealed by a report from 200 farmers of North Dakota. Thirty-four percent reported losses from coyotes and 42 percent from dogs. Of the total number of sheep kept there was a loss of one-third of 1 percent due to coyotes and one-fourth of 1 percent due to dogs. To restrict sheep only requires a comparatively simple fence, but to protect sheep from predatory animals requires more expensive construction. The extended arm (fig. 12) discourages dogs from jumping over the fence. In some of the sheep-raising sections of Texas an apron of 18 inches of woven wire is laid on the ground, fastened to the woven wire adjacent to the ground, and weighted down with rocks or stakes so as to prevent burrowing below the fence line. The fence shown in figure 13 has such an apron. Woven-wire fences (figs. 13 and 14) are particularly valuable for large sheep lots or pastures. Standard woven-wire

specifications are often used for sheep fences, but in semiarid and high-plateau regions lighter wire is commonly used.

Figure 15 suggests forms of fencing suitable for various purposes and in many cases their advantages are obvious.

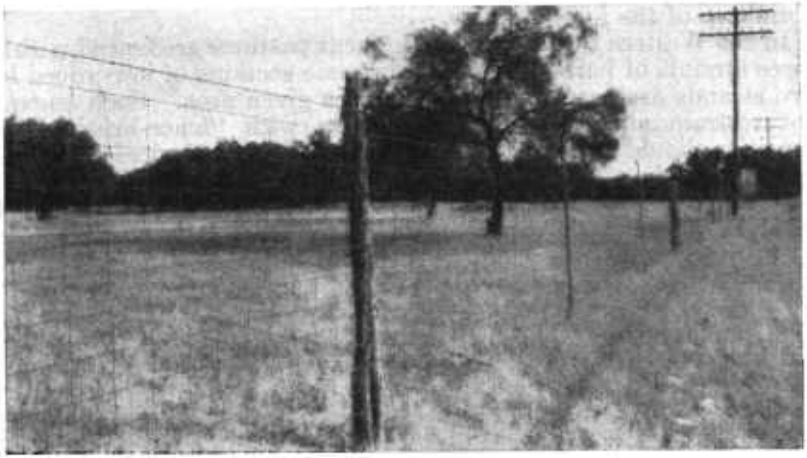


FIGURE 13.—A dogproof sheep fence with wide spacing of posts. The wires between posts are supported on wooden stays.

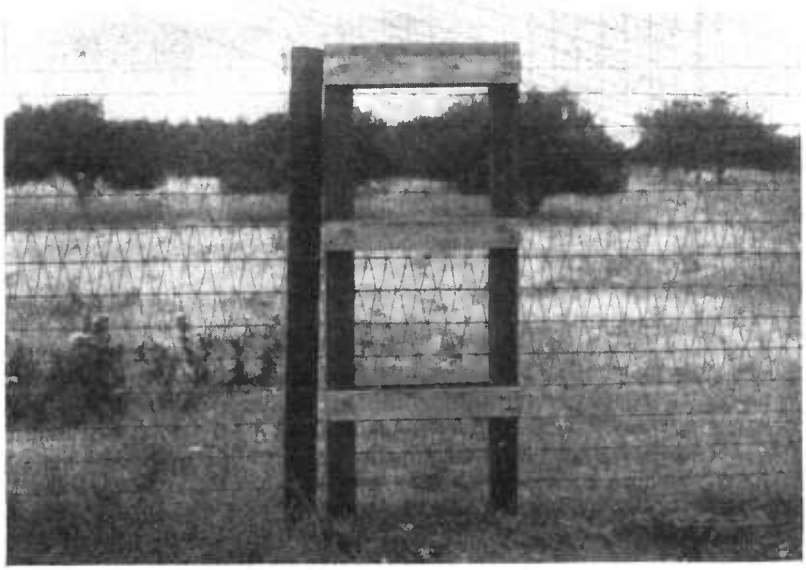


FIGURE 14.—A diamond-mesh fence for a sheep paddock or orchard. The ladder-form stile saves fence and clothes repair.

Protection of young orchards, nurseries, or truck gardens from rabbits and other rodents is often necessary. Large areas may be most effectively protected by using 1½-inch mesh or finer-mesh netting about 3 feet high. Where only a small number of scattered

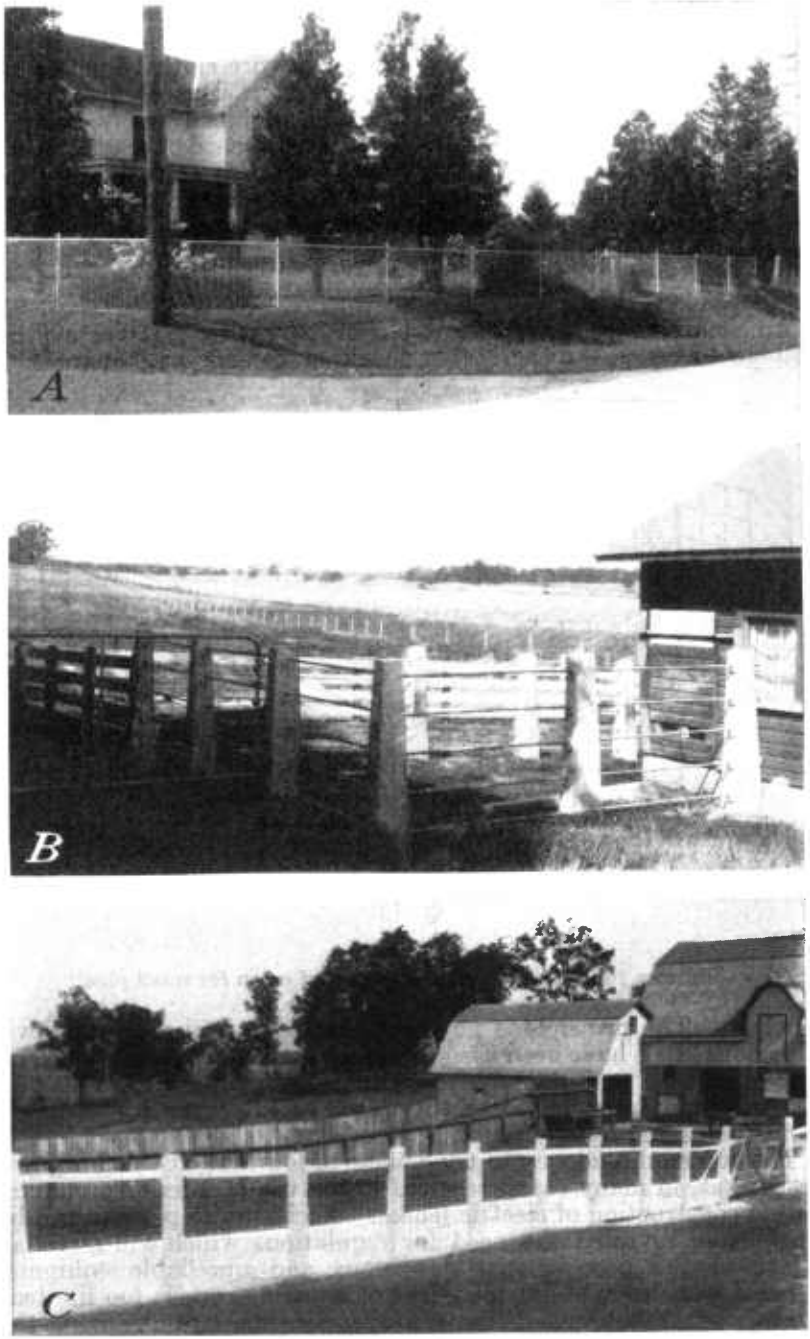


FIGURE 15.—Useful forms of fences: *A*, An attractive lawn fence adds beauty to the farmstead; *B*, a safe bull pen is good life insurance; *C*, a windbreak on the feed lot is a feed saver.

trees are to be protected shields or netting are placed around the trunk and afford considerable protection. For protection against cottontails, 1-inch mesh poultry netting or wire cloth 18 inches wide is used. To keep out jack rabbits and in regions of heavy snow, higher shields are needed to prevent the rabbits from reaching the trunks or limbs above the shield. Veneer boards, heavy building paper, gunny sacks, or cloth wrappings are also of temporary help.

A pen or creep is used for separate feeding of small pigs. This pen should have two or more openings which permit pigs to enter but keep the older hogs out (fig. 16).

ELECTRIC FENCES

An electric fence is a barrier of one or more wires carrying sufficient voltage to cause a disagreeable shock to persons and animals that

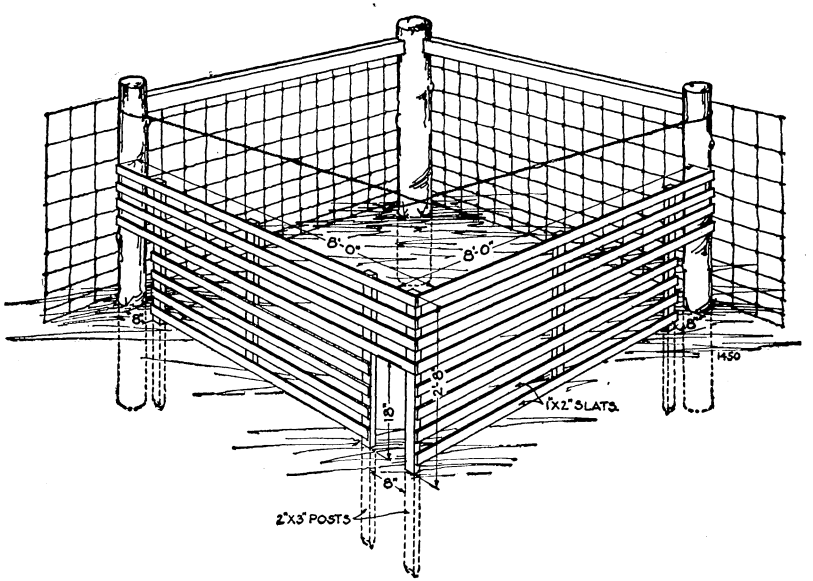


FIGURE 16.—Design for construction of creep for small pigs.

touch it. The principle is not new, since electrical shocking devices of various kinds have been used for more than 30 years and the electric fence has been manufactured commercially for more than 20 years. Electricity in appreciable quantity, even at extremely low voltage, is dangerous if improperly used.

The common tendency to try devices of low first cost and improved design has, in many cases, resulted in the use of inferior products or unsafe construction of electric fences. Accidents to persons and livestock have revealed the need for regulations which will reasonably safeguard the user against dangerous and unreliable equipment. Present knowledge about the effect of electric shock is too limited to justify definite statements as to proper safeguards, but among those generally accepted are the following:

1. Maximum current output must be limited. It is the quantity or amperage of current passing through the body that is responsible for injuries from electric shock. By proper design of the controlling device the amperage may be limited

effectively with whatever voltage is used. On the other hand, if the amperage is not properly limited by the controlling device, even low voltages may cause dangerous shock if the subject is standing on wet ground or in contact with a grounded object. The amount of current required to cause "freezing" to the conductor varies with different people, but one one-hundredth of an ampere—10 milliamperes—seems to be the maximum permissible limit to avoid "freezing."

2. Interrupted current with duration of charge not to exceed one-tenth of a second. The intervals between charges should be long enough to afford time for the victim to free himself.
3. Controlling mechanism designed so that the circuit-breaking device cannot stop in closed position.
4. Current controller to be sealed in a tamperproof box.
5. Housing and nonconducting parts of controller to be effectively grounded.
6. No device of poor construction to be approved.
7. Full instructions for installation and use to be furnished by the manufacturer of electric fences with each controller. These instructions should be followed faithfully.
8. The fence to be equipped with lightning arrestors to prevent loss of property and livestock.

The principal uses of electric fences are:

1. For supplementary fencing or for temporarily enclosing pastures, feed lots, or haystacks or for dividing off fields of corn or other crops to be hogged down.
2. For placing inside bull pens to decrease the damage to the usual heavy fences which safety demands should always be used.
3. To discourage prowlers and predatory animals.
4. For the fencing of marginal land which does not warrant investment in the usual permanent fencing; for areas where good fence posts are scarce; and for rocky land where it is hard to dig post holes.
5. As a protective measure against depredation of wildlife, electric fences have been used with variable success. Four charged wires have kept bears out of apiaries; and two wires may keep deer and antelope away from haystacks.

Advantages claimed for the electric fence are:

1. Low cost. The relative cost of an electric fence and a conventional barbed-wire fence will vary with the length of the fence. In long fences the cost of extra wires and posts may more than equal the cost of the controller and connections. Although fewer posts are required for the electric fence, the properly constructed fence includes insulators. The amount of electrical energy consumed by the electric fence is practically negligible, but this item may be offset in part at least by the cost of keeping the vegetation cut along the fence.
2. One wire required. This claim may be correct where stock of one kind and one size are to be restrained but not if the stock is of different kinds and sizes.
3. Easily moved.

The principal disadvantages of electric fences are:

1. There is danger of loss of human lives as well as of livestock.
2. Livestock require initial training to respect charged wires.
3. The current may cease to flow and the stock get out, resulting in damage to the owner's or his neighbor's property.
4. An electric fence cannot be depended upon to stop infuriated bulls or stampeded animals.
5. Weeds, grass, or shrubbery may ground the fence wire; and it may be necessary to cut weeds and grass several times a season.
6. Some types of electric fences need adjustment to weather conditions; dry soils require higher voltage, which, in turn, with some designs, increases the potential danger if the voltage is not reduced when wet weather comes.
7. Some units may cause interference with radio reception.

It is dangerous to use electric-fence controllers constructed by untrained and unskilled workmen. Unless the builder of such devices is thoroughly familiar with the requirements and characteristics and has the necessary equipment and tools to construct them, he will likely have difficulty in manufacturing controllers that will come up to the generally accepted standards; nor would he be likely to

obtain approval from the State electrical inspection service (in States where inspection is compulsory) for the use of his device without first submitting it to some recognized laboratory for test.

Fatalities resulting from electric fences have been instrumental in causing some States to set up regulations concerning their use. Before buying or installing an electric-fence controller investigate local and State ordinances, ascertain whether their use is permitted and what the regulations are concerning their installation and use.

Many engineers believe that, no matter how carefully these devices are designed and built, they are subject to mechanical break-down or to insulation failure and that the same precautionary measures should apply to the use of the electric fence as to any other uninsulated or unprotected electric conductor. For these reasons the user of an electric fence should become familiar with precautionary measures.

A severe electric shock, regardless of the source of electricity, is likely to paralyze the muscles that control breathing or to interfere with the regular rhythmic beating of the heart. To resuscitate from electric shock use the same methods of restoring respiration as in cases of asphyxiation from gas or drowning and call a doctor at once.

FENCE POSTS

WOOD POSTS

Three classes of material are commonly used for fence posts; wood, metal, and concrete. Bois d'arc, or Osage-orange, black locust, red cedar, oak, and catalpa are the most durable wood posts but are not available in all sections. Other native woods are used in areas suitable for their growth. In many areas the farm woods are an important source of fence posts. Waste or otherwise untillable land may be used for woodland. The best trees should be selected for posts and the lower grades for firewood. The local or State forestry department can recommend the best species to grow in a given area.

Where timber is plentiful, the use of wood posts naturally predominates over that of other materials. Posts low in first cost are often not the cheapest when length of service is considered. Hence the farmer should select the most durable post available or treat the less durable wood. Posts should last as long as the fencing attached to it, or the maintenance cost will be high.

The different species of wood may be divided into three classes: (1) The most durable, which give good service without treatment; (2) durable woods which gives fair service without treatment but may be economically treated to increase their life; and (3) comparatively short-lived species that must be treated to give satisfactory service.

In the first or most durable class are Osage-orange or bois d'arc, red cedar, chestnut, black locust, and catalpa, with an average life of from 15 to 30 years or more; in the second class white oak, cypress, mulberry, sassafrass, black walnut, tamarack, cherry, hackberry, bur oak, hemlock, white walnut or butternut, and redbud, with a life from 8 to 16 years; in the third class elm, larch, honeylocust, and sap cypress, with a life from 4 to 8 years; pine, willow, ash, birch, cottonwood, aspen, maple, hickory, ironwood, sycamore, sugartree, dogwood, and persimmon, lasting from 3 to 6 years. Boxelder, basswood, gum, and bay are of little value untreated, and the cost of treating is ofttimes not economical. Humid climates, because of drying and

wetting, are naturally more destructive to wood posts than are semi-humid or arid climates. However, in arid regions the portion of post above ground dries out excessively and permits entrance of fungi into the cracks which eventually may cause destruction of the post.

The practice of seasoning posts is variable and its value not fully demonstrated. However, peeling and seasoning is generally recommended. The wood between the sapwood and heartwood is the most durable and the sapwood is least durable. Posts cut before the sap begins to run are more durable than those cut while the sap is running.

Tops of posts are often given a slope of not less than one-fourth pitch with the high side next to the wire. Some posts have double pitch, while the top of a round post may be tapered somewhat. It is thought that doing this helps the post to shed water better and so increases its life, though no tests are available to prove this statement.

PRESERVATIVE TREATMENT

The advisability of treating wood fence posts depends upon the available supply and cost of posts of durable woods as compared with treated but less durable woods. Preservative treatment makes possible the economical use of home-grown material otherwise unsuitable for posts. The cost of creosote treatment varies widely from a few cents to 15 or 18 cents per post. The longer life of treated posts may justify the cost of treatment. Equipment for treating fence posts can often be purchased jointly by two or more farmers. Information on the different preservative treatments can be obtained from the State agricultural colleges or from Farmers' Bulletin 744, Preservative Treatment of Farm Timbers.

Different forms of home treatment are available. The principal ones are as follows: Carbolineum; creosote, both of wood or gas tars; zinc chloride; charring; and filling post holes with gravel for drainage. Different kinds of salts, acid and limewater, mercuric chloride, sodium fluoride, and other substances have been tried but are not used extensively. A preservative should be safe for use and reasonably cheap, penetrate the wood readily, be noncorrosive to metals, not wash out easily, and be poisonous to fungi.

In southern climates or where conditions are favorable to decay, treatment of the entire post is feasible. Elsewhere treatment of tops and butts is practical and economical. In the butt treatment a portion of the post 1 foot above and below the ground line is treated, in accordance with the soil conditions (p. 23). Carbolineum and creosote may be applied with a brush, but brushing is more effective with carbolineum than with creosote, for which the tank treatment is generally preferable. Zinc chloride is usually not recommended for brush treatment and is not as satisfactory as good creosote.

Table 4 is based on experiments made in Missouri with 26 varieties of wood posts for a period of 23⅓ years. While the results shown apply to the conditions under which the tests were made, the table is of value as showing the comparative durability of different kinds of wood without treatment or with one of the treatments listed. The annual service costs were computed by adding 4 cents for setting and the cost of the treatment to the initial cost of the post and dividing by the years of service obtained. The last three columns indicate which treatment gave the longest life and the least

annual service cost. For example hickory posts lasted 12 years when creosoted 2½ hours (G) but gave the lowest annual service cost when treated with carbolineum (D). When untreated, they lasted only 3.6 years, as shown by the third column.

TABLE 4.—*Comparison of different wood posts with respect to cost, durability, efficiency of treatment,*[1] *and annual service cost as observed over a period of 23½ years in Missouri* [2]

Kind of wood	No treatment			Annual service cost [3] for kind of treatment indicated						Best treatment		
							Creosoted			For longest life		For least annual cost [1]
	Local cost of post	Test life	Check	Set in gravel	Butts charred	Carbolineum	Brush	Tank 1 hour	Tank 2½ hours	Kind	Life	
			(A)	(B)	(C)	(D)	(E)	(F)	(G)			
	Cents	*Years*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*		*Years*	
Osage-orange	30	[4]										A
White Cedar	30	[4]		1.61	[4]	[4]						A
Catalpa	22	[4]										A
Black locust	20	21.5	1.12	2.20	1.52	1.33	[4]	[4]	[4]			A
Sassafras	16	16.0	1.25	1.26	1.79	3.62	1.42	1.67	2.16	G	17.6	A
White oak	15	13.6	1.40		3.19	1.12	2.94	1.67	1.85	G	20.0	D
Black walnut	15	9.3	2.20	2.52	3.06	1.87	2.35	1.39	2.10	F	20.0	F
Kentucky coffeetree	15	6.3	3.02	2.24	2.60	2.10	1.68	1.54	1.74	G	21.3	F
White walnut	15	11.0	1.73	1.65	2.60	1.61	2.28	2.13	2.54	G	14.6	D
Redbud	12	10.3	1.55	2.22	1.67	2.15	2.80	1.73	2.37	F	14.3	A
Red oak	12	3.6	4.45	2.57	2.76	2.15	5.12	2.26	2.22	G	15.3	D
Honeylocust	12	5.3	3.02	1.44	3.21	1.37	2.28	1.59	2.78	F	15.6	D
Black oak	12	3.0	5.33	3.76	6.85	2.86	2.38	1.91	2.83	F	13.0	F
Black ash	12	4.3	3.72	3.51	4.20	3.33	5.13	1.77	1.83	G	18.6	F
Ironwood	12	3.6	4.45	4.50	6.42	2.08	6.40	2.06	2.50	G	13.6	D
Hickory	10	3.6	3.89			1.46	4.00	2.46	2.67	G	12.0	D
Hackberry	10	3.3	4.25		8.64	3.90	6.15	3.46	2.90	G	11.0	G
White elm	8	4.0	3.00	3.40	4.64	1.67	4.12	1.89	3.76	G	8.0	D
River birch	8	3.0	4.00	2.65	4.63			2.60	3.12	G	9.6	F
Sycamore	8	2.0	6.00	6.00	2.43	4.00	8.25	2.24	3.75	F	9.3	F
Dogwood	8	3.0	4.00	3.70	4.64	4.38	4.60	2.24	2.38	G	12.6	F
Persimmom	8	2.6	4.62	4.06	6.50	4.85	5.00	2.42	3.75	F	8.6	F
Sugar tree	5	3.3	4.22	5.06	3.73	3.63	.38	3.56	3.86	G	7.0	E
Willow	5	2.3	3.90	3.64	5.35	3.25	5.20	1.92	2.08	G	13.0	F
Cottonwood	5	3.3	4.22	4.22	4.74	3.25	4.10	2.12	3.38	F	8.3	F
Basswood	5	2.3	3.90	4.60	5.35	5.00	6.75	3.88	3.25	G	8.3	G

[1] Letters A to G are used for convenience in designation of test treatment.
[2] Data compiled from Bulletin 374 Missouri Agricultural Experiment Station, Effect of Treatment of Fence Posts.
[3] Annual post cost per year equals sum of first cost, cost of treatment, and setting cost divided by years of service.
[4] No failures observed during period of test.

Paints as a general rule retard but do not prevent decay. The result obtained by such coating is largely that of improving the appearance or increasing the visibility of the fence (fig. 17). Dipping posts in cement paint or paste is mostly wasted effort.

Setting posts in concrete is usually bad practice since the post shrinks from the concrete, leaving a crack for moisture to enter, with little opportunity for the absorbed moisture to evaporate, thus causing the post to quickly rot at the junction line of the two materials. With durable woods or treated posts the stability and convenience of concrete for anchorage often justifies its use. The concrete collar should extend well above ground, and the top edge should be sloped so as to give good drainage.

SIZE OF POSTS

The size of wood posts varies considerably with the strength and durability of the species used. Line posts of Osage-orange are sometimes as small as 2½ inches in diameter. With other woods line posts

are commonly 4, 5, or 6 inches, and corner posts and gateposts 8 to 12 inches in diameter. The least dimension for split posts is usually not less than 5 inches. Large posts usually last longer than smaller posts of the same wood.

Posts usually are set 2½ feet in the ground and extend about 6 inches above the top wire. The over-all length, of course, depends on the height of the fence but is generally 7, 7½, or 8 feet for line posts, while gateposts and brace posts are of sufficient length to meet the service required.

In stiff dry soil, the post usually decays first just below the top of the ground. In porous or sandy soil they usually rot from the top down. Posts that are in continually damp soil rot very slowly, while in soils with widely varying moisture content they are likely to rot most rapidly at the ground line. In shallow or rocky soil it is often

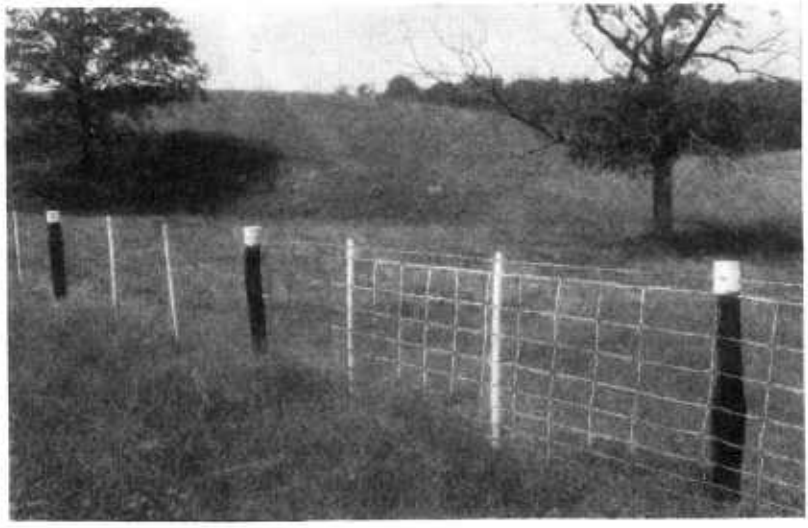


FIGURE 17.—Creosoted posts with painted tops, together with intermediate stays increase the visibility of fence for horse pastures.

impractical to set posts in the ground, and special types of posts are required (figs. 18 and 19).

METAL POSTS

Metal posts are made of steel, or alloyed steel, and wrought iron. Copper-bearing steel or rust-resistant alloys are desirable if the added alloy is sufficient to prevent corrosion. Metal posts may be obtained either painted or galvanized. No authentic tests of long standing are available on the comparative durability of such posts. However, observations made at the South Dakota and the Arkansas Agricultural Colleges showed that galvanized posts were in good condition after 10 years, whereas the painted posts had lost about 80 percent of their coating and were rusting badly.

In a given locality a painted metal post may be obtained for 35 cents; the same post galvanized would cost about 50 cents. The high cost of metal posts is a disadvantage, but there are certain advantages which tend to offset this. Metal posts protect stock against lightning

by grounding the current, they are light in weight and easily handled and may be easily driven into most soils, which reduces the labor and cost of setting. Like concrete posts, metal posts permit the burning

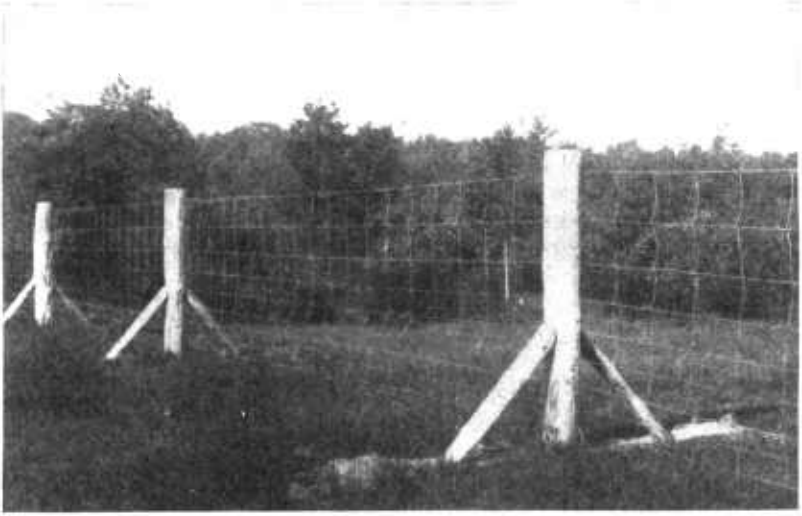


FIGURE 18.—In shallow soil above rock, posts may be set in sills and braced.

FIGURE 19.—Rock-filled corner post or gatepost for stony land.

of weeds and trash in the fence line. However, this burning should always be done on a day when the wind is blowing away from the fence; otherwise the heat of the fire may seriously damage the galvanizing on the wires and posts.

Metal posts are made of two different weights and in four general shapes or forms: The angle iron; tee form in light, heavy, and deformed; channel, or U-bar, of various shapes; and the pipe, or cold-rolled circular split form. A number of devices are employed for fastening the wires to the metal posts (fig. 20). These various shapes may be punched, perforated, lipped, studded, or otherwise deformed. Decreasing the area of contact of post and line wire for the purpose of drainage and reducing rust is accomplished by deformation or embossing. If the posts are lipped (fig. 20, *F*) so as to provide self-

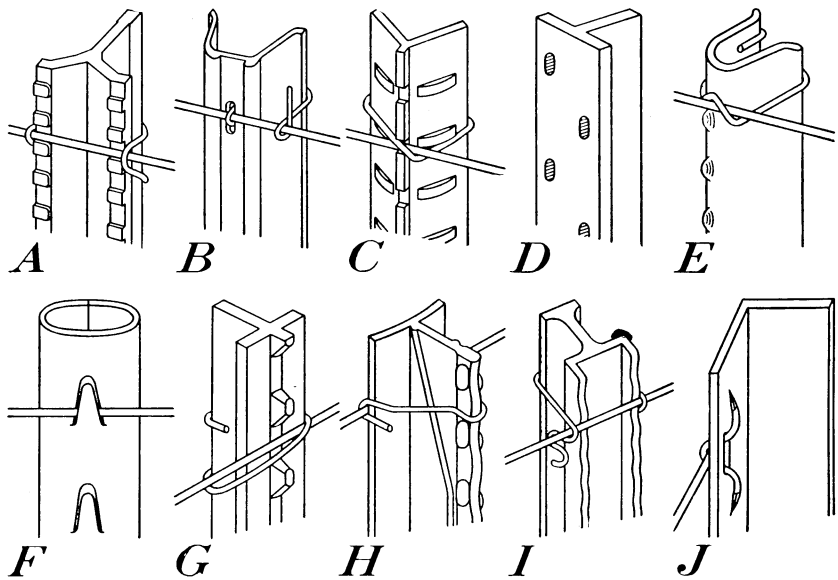


FIGURE 20.—Steel farm fence posts, showing typical shape, wire binders, and surface treatment. Shapes or forms: Angles, *C* and *J*; tee's, *A*, *D*, *G*, *H*, and *I*; channel or U-bar, *B* and *E*; circular *F*. Binders: Twisted wire, *C*; staples, *D* and *J*; slip on, *G* and *I*; clip and twist, *A*, *B*, *E*, *H*; lipped, *F*. Surfaces: Studded, *C* and *G*; embossed, *A*, *C*, *E*; channelled, *A*, *B*, *I*; perforated or punched, *B*, *D*, and *J*.

fasteners, the metal must be sufficiently ductile to stand bending without breaking. The weights of the common forms of metal posts are given in table 5.

TABLE 5.—*Approximate weight and sizes of common metal posts for farm fencing*

Shape	Nominal size	Weight for posts of length indicated								
		5 feet	5½ feet	6 feet	6½ feet	7 feet	7½ feet	8 feet	9 feet	10 feet	11 feet
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Round	No. 8 gage, 2½ inches	(1)	(1)	27.1	(1)	29.1	31.0	32.9	36.6	40.4	44.1
Do	No. 14½ gage, 1¾ inches	7.0	(1)	8.4	9.1	9.8	10.5	11.2	[2] 15.2	[2] 16.7	[2] 18.3
Angle L	1¼ by 1¼ by 9/64 inches	6.20	6.76	7.32	7.88	8.44	9.00	9.56	------	------	------
Light T	1⅜ by 1⅜ by 9/64 by ⅛ inches.	6.92	7.55	8.17	8.80	9.42	10.05	10.67	------	------	------
Heavy T	1½ by 1½ by ⅛ by ⅛ inches.	7.32	7.99	8.65	9.32	9.98	10.65	11.31	------	------	------
Channel	1 5/16 by 1 3/16 by 25/32 by 3/64 inches.	6.20	6.76	7.32	7.88	8.44	9.00	9.56	------	------	------

[1] Not commonly made in this length.
[2] For corners and braces, 13½ gage.

Objections to steel posts are the lack of resistance to the pressure of stock and the ease with which lightweight posts are bent. In order to resist the pressure of the stock crowding the fence, anchor plates bolted, clamped, or riveted to the base of the post are used to help retain fence alinement. These are usually in three general forms: Flat plate, bent plate, and split wing, as shown in figure 21.

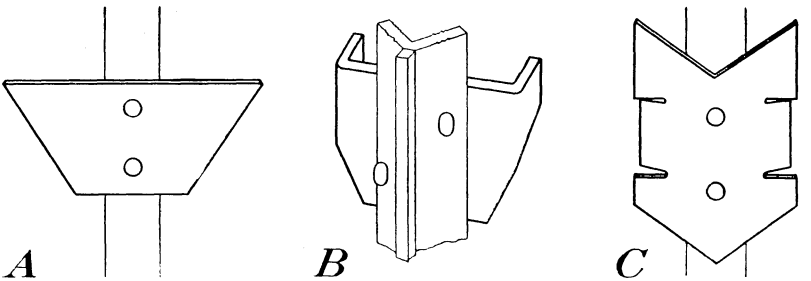


FIGURE 21.—Common forms of steel-post anchors: *A*, Flat plate; *B*, flat plate bent; and *C*, split wing.

In some areas close to oil fields, boiler factories, or repair shops used pipe may be obtained at reasonable prices for fence posts. These should be at least 1¾ inches in diameter for line posts and larger for corner posts. Heavy corner posts or gateposts can be made of pipes 6 or 8 inches in diameter filled with concrete.

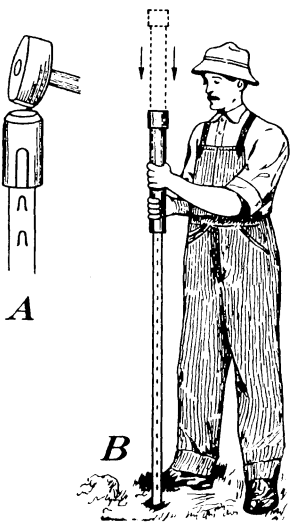


FIGURE 22.—Methods of driving steel posts: *A*, Post maul or sledge with driving cap protecting top of post; *B*, driving post with weighted sleeve.

Metal posts may be easily and quickly driven in heavy clay soils with an ordinary 12- to 16-pound steel sledge or post maul, in which case a driving cap (fig. 22, *A*) is used. In lighter soils, a 16-pound sleeve driver that can be operated by one man may be used (fig. 22, *B*). This method of setting posts, where feasible, saves considerable labor over that of digging and tamping holes.

CONCRETE POSTS

Concrete posts, when properly made, will give satisfactory service. Figure 23 shows a post that is more than 20 years old. Where sand and gravel are available and farm labor and equipment can be used advantageously, concrete posts can be made on the farm. Bulletins that give directions for making the posts may be obtained from local cement dealers or the Portland Cement Association. Success in making concrete posts depends on proper mixing and the use of suitable aggregate, the kind of reinforcing used and its proper placing,

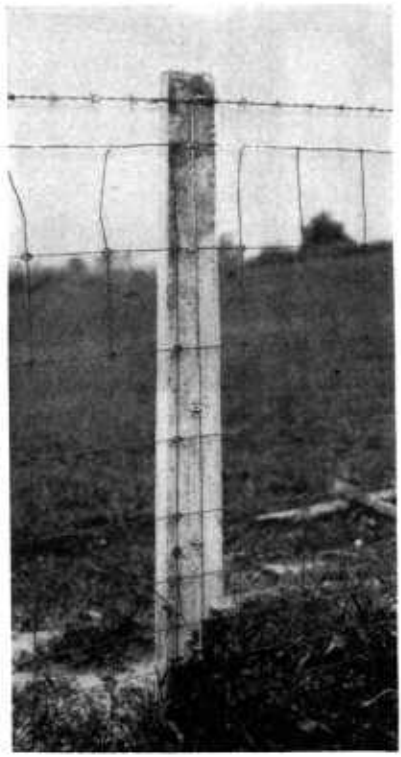


FIGURE 23.—Concrete fence post supporting woven wire fence with stiff stays. Wire fastener molded in posts are seldom in position to fit line wires.

care in handling green posts, proper curing or seasoning before use, and careful handling to avoid breaking or cracking.[2] Unless these principles are observed, failure is likely to result.

Concrete gateposts and corner posts are made in various sizes and shapes (figs. 24 and 25) to fit various conditions. These are usually cast in place and should be thoroughly cured before the fence is attached. It is essential that they be made of good concrete and properly reinforced.

WIRE AND POST FASTENERS

Nails, staples, twisted wire, and various forms of clips are used to fasten boards and wire fencing to the posts. In the days when nails

[2] See Farmers' Bulletin 1772, Use of Concrete on the Farm.

and wire were difficult to obtain, mortised posts (fig. 1, *D*) were often used.

No. 9 wire is ordinarily used for fence staples. The length and style will vary with the hardness of the wood post used: ¾- and 1-inch

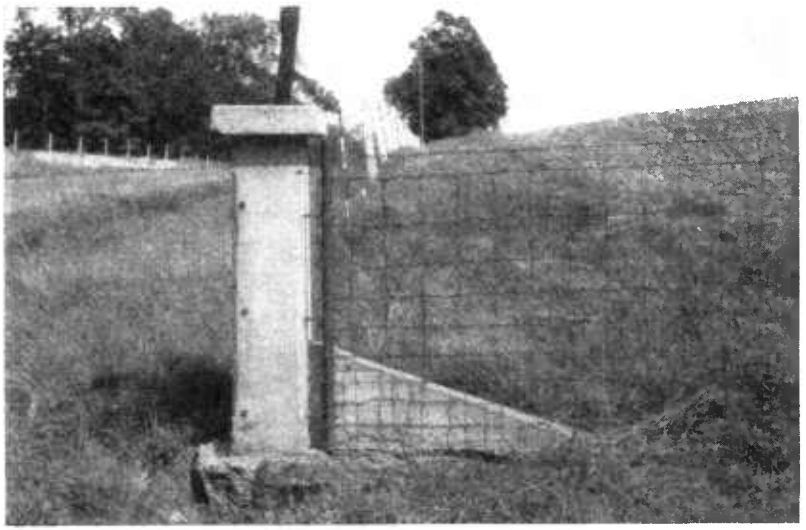


FIGURE 24.—A concrete corner post with a wing brace. The pipe bolted to the post permits tension adjustment of the fence line.

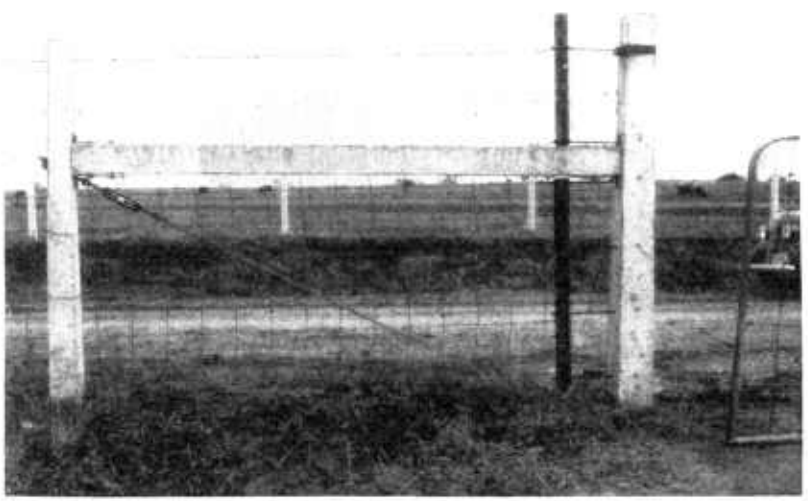


FIGURE 25.—A precast gatepost with a concrete brace. Tension in fence wire is adjustable, and brace wire is fitted with a turnbuckle.

are satisfactory for bois d'arc, while 1¼- and 1½-inch staples are used for the softer woods. Less splitting of the wood will occur if the staples are driven in diagonally to the grain. They should be set so as to hold the wire securely but should not be buried in the post, as

this often nicks or bends the wire and results in rapid corrosion. Staples for poultry netting vary widely in their requirements, but special staples for steel posts (fig. 20, *J*) are made of No. 10 gage. The fence should be fastened to the post in such a way as to allow for contraction and expansion and distribution of strain caused by the crowding of stock.

Tables 6 and 7 are convenient for estimating the quantity of staples and fasteners needed to build 80 rods of fence. These tables are based on an allowance of seven staples per post, which is the average number used for the styles shown in figure 5. In estimating for a 2-, 3-, or 4-line barbed-wire fence, corresponding reductions should, of course, be made.

TABLE 6.—*Quantity* [1] *of staples required for various spacing of posts*

Post spacing (feet)	Posts per 80 rods	Staples of size indicated for 80 rods of fence			
		¾ inch	1 inch	1¼ inches	1½ inches
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*
8	165	7.97	11.22	15.08	16.83
10	132	6.37	8.98	11.15	13.47
12	110	5.32	7.48	9.29	11.22
16½	80	3.87	5.44	6.76	8.16

[1] Allows for 7 staples per post, with 5 percent added for loss or waste.

TABLE 7.—*Number of staples* [1] *per pound according to length and gage*

For poultry netting			For fence wire		
Length (inches)	Wire gage	Staples per pound	Length (inches)	Wire gage	Staples per pound
	Number	*Number*		*Number*	*Number*
¾	14	480	¾	9	152
⅞	14	416	1	9	108
1	14	352	1¼	9	87
1½	10	84	1½	9	72

[1] Wire staples for steel posts, see fig. 20, *J*.

The use of metal and concrete posts has caused the development of many new fasteners or clips. Figure 20 shows several of the common forms now in use. Each manufacturer furnishes special clips particularly suited for his post. A fastener should provide good drainage of water, be easy to fasten or remove, and retain a minimum of dirt as it hastens corrosion. In the lipped form (fig. 20, *F*) a tap with the hammer serves to fasten the wire. Such forms must permit the fastening or removal of wire several times without danger of breaking.

Previously, several forms of fasteners were used on concrete posts: Inserts cast in post (fig. 23), bolted nailing strips on the side (fig. 6), or wire wrapped around the post (fig. 25). The latter method is most commonly used at present.

SPACING OF POSTS

The life of the fence and the maintenance cost are closely associated with the size and spacing of the fence posts. Most of the better fences observed had a spacing of about 12 feet and many

miles of field fences are built with a spacing of 1 rod. In large pastures in the West where unit acreage per head is large, spacings up to 50 feet are sometimes used, the wires in between the posts being supported by wood stays or smaller posts, similar to those in figure 13. From tables 8 and 10 it may be seen that it is cheaper to add a single strand of wire at a cost of 4 to 5 cents per rod than to space the posts closer. In areas where post timber is scarce this is a common practice. In land where rock underlies shallow soil the task of digging post holes may be reduced by using fences like those shown in figures 18 and 26; in some cases stone anchors or piles of stone are used (fig. 19).

FIGURE 26.—A panel fence suitable for stony land.

The size of stays or small intermediate posts varies considerably. Stays 1½ to 2½ inches in diameter are used in sheep areas to reduce the cost of fencing and maintain an upright fence (fig. 13). Stays are also used in horse areas not only to hold up the wires but also to increase the visibility of the fence (fig 17). Wire droppers sometimes are twisted into the line wires to give greater stiffness to the fence and to reduce the spread between wires, but this practice may hasten the corrosion of the line wires. In dry areas the practice is less objectionable than in humid areas.

If heavy livestock are to be confined in small lots or pastures the posts are often set 8 feet apart, which greatly increases the service life of the fence. Closer spacing of posts is required for hogs than for sheep, although the same height of fence may be used for both.

Figure 27 shows clearly that the shape of the field affects materially the length of fencing required per unit area and emphasizes the importance of this factor when laying out fields. Ten acres in the form of a square requires 160 rods, whereas if the width is but one-fourth the length, 200 rods are required to fence the same area. As the size of the field increases the requirement per acre decreases.

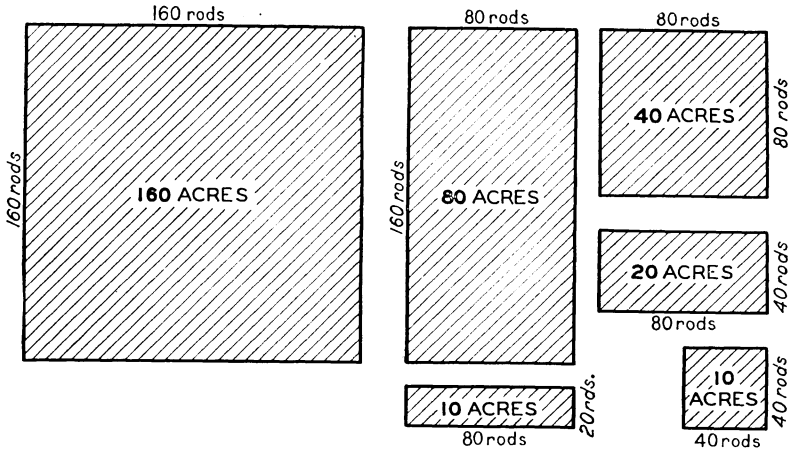


FIGURE 27.—Arrange fields so as to permit economy of fencing and cultivation.

TABLE 8.—*Cost per rod for various spacings of posts costing 30, 50, and 80 cents each in the order mentioned*

Spacing of posts in feet			
8	10	12	16½
Dollars	*Dollars*	*Dollars*	*Dollars*
0.62	0.49	0.41	0.30
1.03	.82	.68	.50
1.65	1.32	1.10	.80

LIFE OF FENCES

The life of farm fences is difficult to determine because of the wide variation in conditions affecting its length of service. The data given in table 9 and on page 22 are of value in weighing the effects of certain factors. However, in general, the life of a fence depends upon the weight or gage of wire.

TABLE 9.—*Distribution, life, and use of woven-wire and barbed-wire fencing on different types of farms in Illinois* [1]

Item		Grain	Dairy	Livestock	Mixed
Average size of farm	acres	184.4	148.3	181.4	122.9
Fence per acre	rods	5.12	6.18	5.8	6.03
Woven wire	percent	22.9	21.3	51.5	9.8
Age:					
Less than 12 years	do	63.0	43.3	55.0	24.2
Over 20 years	do	4.2	25.2	6.1	34.8
Condition:					
Excellent	do	22.9	8.1	18.9	3.8
Poor	do	31.8	31.3	20.7	49.4
Barbed wire	do	60.9	78.6	10.7	77.5
Age:					
Less than 12 years	do	82.8	37.2	47.6	19.0
Over 20 years	do	1.4	27.8	9.3	54.3
Condition:					
Excellent	do	13.3	3.8	16.8	1.4
Poor	do	20.9	37.5	34.2	62.8

[1] From Report and Analysis of Fence Survey in Illinois, by R. W. Wright, University of Illinois. Unpublished.

The service given by different widths of woven wire [3] has been found to be as follows: 26 inches, 17.2 years; 32 inches, 17 years; 36 inches, 18.3 years; 39 inches, 18.8 years; 42 inches, 19.9 years; 45 inches, 21.7 years; 47 inches, 18.9 years.

The following tabulation indicates the service given by different weights of woven-wire fencing:

Size of wire:	*Years*
No. 9 throughout	21
No. 7 top, No. 9 bottom laterals, and stays No. 11 or No. 12	20
No. 9 top and bottom No. 10 laterals and stays	19
No. 9 top and bottom, No. 11 laterals and stays	18
No. 9 top and bottom, No. 12 laterals and stays	17
No. 9 top and bottom, No. 11 laterals, No. 12 stays	18
No. 10 top and bottom, No. 11 laterals and stays	17
No. 11 top and bottom, No. 12 laterals and stays	15
No. 12 top and bottom, No. 14 laterals and stays	13

COST OF FENCING

The initial cost of large-size wire is more than that of the smaller sizes, but it is more economical in the long run because of its longer life. The cost of construction for the heavier fencing is practically the same as that for the lighter weights. Also the greater widths are more durable than the narrow ones, and the cost of maintenance is less.

The number of rods of fence that may be erected in a day, will vary with the soil condition, topography, efficiency of labor, and type of fence erected. No single table of cost data can be prepared which will enable a farmer to make a close estimate of the cost of any fence for any locality. However, table 10 in combination with the other tables will permit of fair estimates covering a wide range of conditions.

Table 10 is based on a wage of $1.50 per day. Wages paid to skilled fence crews may often be higher, but because of their skill and superior equipment they may do the work at a lower unit cost than common labor.

Data are given for an average day's work under the conditions specified, and a comparison of estimated cost of fence construction using the typical fences shown in figure 5 and with posts set 1 rod apart. The prices assumed are not average prices but are well within the range of farm prices. If the unit price of fence is known, estimates of cost of fencing for other specifications than those given in table 11 may be made by comparing with the price per rod.

[3] From U. S. Dept. Agr. Bull. 321, Cost of Fencing Farms in the North Central States. Out of print.

TABLE 10.—*Cost of materials and labor of woven-wire fencing, with posts spaced 1 rod apart*

[See table 8 for different spacing of posts and table 7 for staples required]

Kind and height of fencing		Cost of No. 11 specification, 6-inch stays		Cost per 80 rods with barbed wire added						Total cost of material [3]	Cost of labor and material for—						
											Posts driven				Posts set		
Standard woven wire [1]	Approximate height	Per rod [2]	Per 80 rods	1 strand	2 strands	3 strands	4 strands	5 strands	6 strands		Rods per day	Labor per 80 rods	Total cost per—		Rods per day	Labor per 80 rods	Total cost per—	
													80 rods	Rod			80 rods	Rod
No.	*Inches*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*		*Dollars*	*Dollars*	*Dollars*		*Dollars*	*Dollars*	*Dollars*
1155	55	0.75	60.00							84.00	65.4	3.68	87.68	1.09	39.0	6.16	90.16	1.13
	58			63.50						87.50	55.3	4.32	91.82	1.14	33.9	7.04	94.54	1.18
1047	47	.65	52.00							76.00	65.4	3.68	79.68	1.00	39.0	6.16	82.16	1.03
	54			55.50						79.50	55.3	4.32	83.82	1.05	33.9	7.04	86.54	1.08
	58				59.00					83.00	53.0	4.56	87.56	1.09	33.0	7.28	90.28	1.12
939	39	.59	47.20							71.20	65.4	3.68	74.88	.96	39.0	6.16	77.36	.97
	43			50.70						74.70	55.3	4.32	79.02	.99	33.9	7.04	81.74	1.02
	54				54.20					78.20	53.0	4.56	82.76	1.03	33.0	7.28	85.48	1.07
	58					57.70				81.70								
832	32	.50	40.00							64.00		3.68	67.68	.84		6.16	70.16	.88
	42				47.00					71.00	53.0	4.56	75.56	.94	33.0	7.28	78.28	.98
	52					50.50				74.50								
726	26	.44	35.20							59.20		3.68	62.88	.78		6.16	65.36	.82
	41					45.70				69.70	53.0	4.56	74.26	.93	33.0	7.28	76.98	.96
	52						49.20			73.20								
Barbed wire		.044	3.50	3.50						27.50		2.72	30.22	.38		3.36	30.86	.36
	36				7.00					31.00	89.5	2.72	33.72	.42	71.5	3.36	34.36	.43
	49					10.50				34.50	89.1	2.72	37.22	.46	58.7	4.08	38.58	.48
	52						14.00			38.00	83.2	2.88	40.88	.51	47.9	5.04	43.04	.54
	54							17.50		41.50	56.7	4.24	45.74	.57	34.1	7.04	48.54	.61
	58								21.00	45.00	56.7	4.24	49.24	.61	26.4	9.04	54.04	.68

[1] See fig. 5 and table 3 for specifications.
[2] Assumed unit price; not an average.
[3] Includes 80 posts at 30 cents each—$24.00.

CONSTRUCTION METHODS

Good workmanship is an important factor in determining the life and service of a farm fence. A careless or loosely built fence will be costly to maintain and will cause frequent annoyance.

After the fence line has been located, the ground should be cleared of all obstructions such as stones, stumps, brush, and trash. When the corners are located, a line of sight poles may be erected at important points or a line stretched. The locations of the post holes are then established along this line and marked with pegs, where exact spacing is necessary. The spacing and depth of post holes are governed by the factors previously discussed (p. 30). An auger, (fig. 28, *B*) is commonly used to make post holes in a loose soil or the

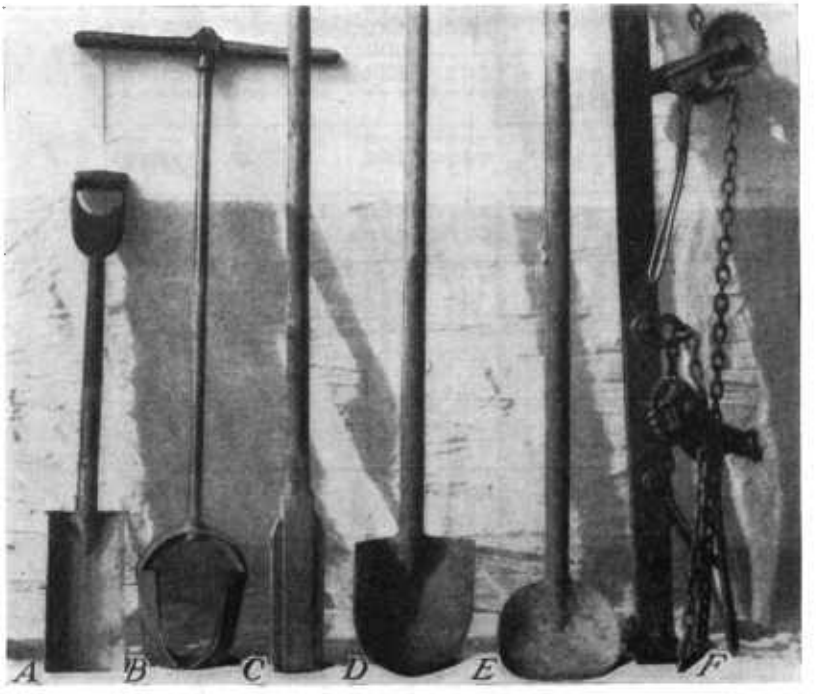


FIGURE 28.—Various tools used in the construction of farm fences: *A*, Spade; *B*, post auger; *C*, post tamper; *D*, round-pointed shovel; *E*, spoon shovel for removing dirt; *F*, two-jack fence stretcher.

black loams of the Corn Belt, while in heavy clays, a spade or digger is used. In stony land it is sometimes necessary to blast.

Steel posts are commonly driven to the desired depth. Occasionally wood posts are sharpened and driven. A driving cap of steel or iron is employed to protect the top end of steel posts when driven with a maul, (fig. 22, *A*). A wood block may be used for the same purpose in driving wood posts. In driving posts with a sledge or maul the work can be done more easily if the driver stands 2 or 3 feet above the ground. A wagon may be used for this purpose as well as for hauling the posts.

One man using a sliding sleeve of approximately 17 pounds weight (fig. 22, *B*) may set steel posts at the desired depth. If long lines of fence are to be erected the use of motor-operated drivers or augers may be justified.

The appearance of the fence line is often marred by setting the posts in irregular alinement or at different heights and spacings. When steel posts are used the fence may be stretched before driving the line post. The fence will maintain alignment and help in obtaining even spacing. The tops of wood posts may be cut off evenly after they have been lined and set. On fairly level ground the post may be set at a regular height by a gage mark on the tamping bar.

A good tamping bar may be made either of steel or wood faced with steel (fig. 28, *C*). A steel bar 1 inch in diameter or an old piece of shafting pointed on one end and with a flat head welded or upset on the other end is very useful. The pointed end may be used in starting holes for driven posts and for removing rock or other obstructions from holes. Posts must be firmly set in order to maintain an erect position. A small amount of soil should be backfilled at a time and well tamped before more is added.

BRACING POSTS

Failures of corner posts are all too common and greatly decrease the life and serviceability of the fence. It is highly important that corner brace posts be firmly set. If concrete is used it must be thoroughly set before the fence is stretched. Posts must not only resist the impact of stock but also, in some localities, the heaving action of frost.

Figure 29 helps to reveal the action of normal forces or strains which may be placed on corner and brace posts. Tests prove that a woven-wire stretcher may exert a force of more than 10,000 pounds and that many brace posts fail under a strain of 6,000 pounds or even less. Hence the importance of proper tension of wire and proper bracing of posts is obvious.

Figure 29, *A*, illustrates a wide woven-wire fence used as line wires to put a uniform or evenly distributed load on the post or an equivalent single load at point *f*. The reaction of the post and braces to the pull of the fence is opposite to that of the fence stretcher and of equal stress. To resist these forces there must be equal resistance offered by the soil to movement of post at point *e* and to overturning at *d*. This overturning action may be transmitted to *c* along the dotted line and thus to point *a* or directly to *b* if the member *cd* is omitted. Any movement of point *d* tends to lift point *a* or *b* out of the ground. Resistance to movement of point *c* equal to that of *d* may be opposed by a brace, *ce*, which is in compression, and hence this member must have stiffness, such as a 4- by 4-inch brace or a piece of pipe. The other members, *ac* and *bd*, are in tension and hence may be held by a wire or rod.

The angle *bce* of the brace is important, since if the posts are too close, less bracing and more uplifting of the post *bc* occurs. Thus, if in figure 29, *B*, we apply the load at the center (*f*) with a brace *ce* at an angle of 45°, the horizontal pull and the uplifting component are equal, as represented by the arrows, and *c* revolves about *e*, with a lever arm of the resultant force applied at point *f*. If the

angle is larger than 45° more uplifting and less bracing occurs, but more bracing is obtained if the angle is less than 45° (fig. 29, *C*). This results in less uplift and more bracing and is further decreased in *D*. However, the flatness of the angle may be overdone as the brace shown in figure 29, *E*, which obtains only the added ground resistance of the second post with no change in the uplift motion.

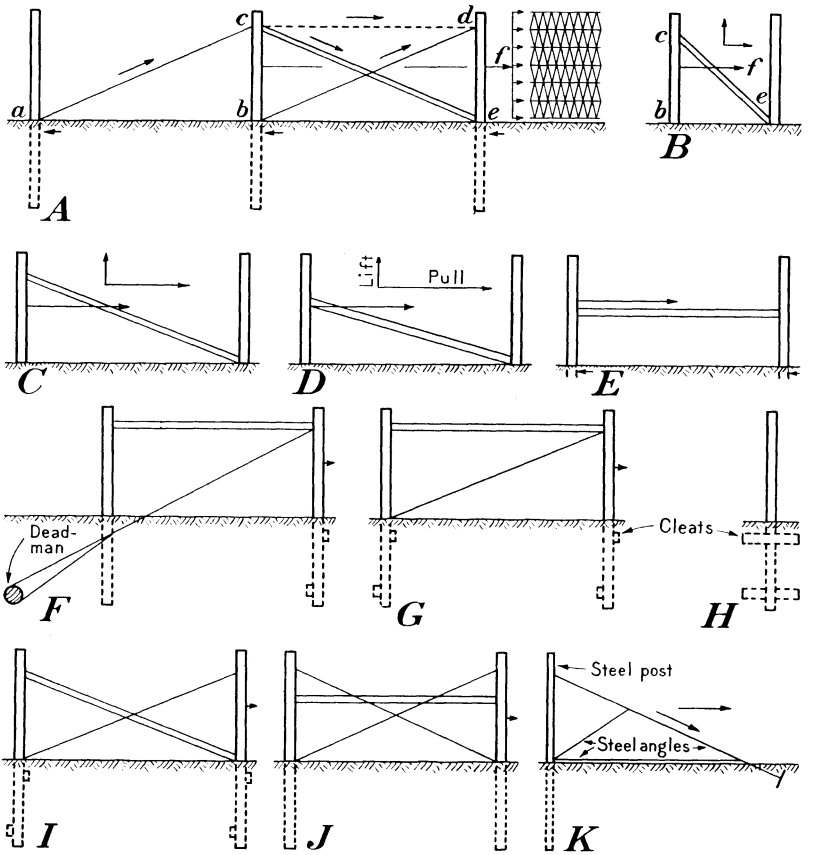


FIGURE 29.—Principles of and general forms for bracing fence posts: *A*, The load or strain of a fence line applied uniformly to post *de*, or concentrated at point *f*, illustrates the compression and tension members of fence bracing; *B*, *C*, *D*, and *E* compare the lifting and horizontal component forces of a fence strain on the brace post as affected by angle of brace of 45° or less; *F*, post braced with a strut and wire to an anchor or deadman; *G* and *I*, post braced by strut and tie; *H*, cleats used to resist movement of individual post, horizontally or vertically; *J*, a less effective form of bracing than *G*; *K*, an effective form commonly used for bracing steel posts.

The brace post should not be closer than 8 feet, but 10 feet is better and permits the use of a brace 12 feet long. In order to reduce the uplift, the top end of the diagonal brace should not be too close to the top of post.

Some of the more common and most effective forms of bracing are shown in figure 29, *F* to *J*. Form *C* is more efficient than *D* since the

brace resists better the overturning of corner post. Form *F* is similar to *G* but much more efficient since the tie is fastened to an anchor, or deadman, and the uplift on the corner post is greatly reduced. The

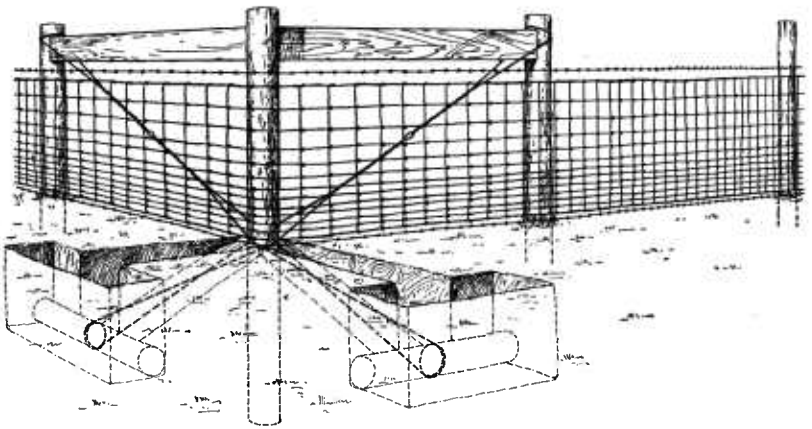


FIGURE 30.—A good corner post bracing using deadmen anchors for brace wires.

brace post carries the fence tension load and permits a smaller corner post. A further use of this principle is shown in figure 30. The form *I* (fig. 29) is least efficient of all; *K* is a very effective form used

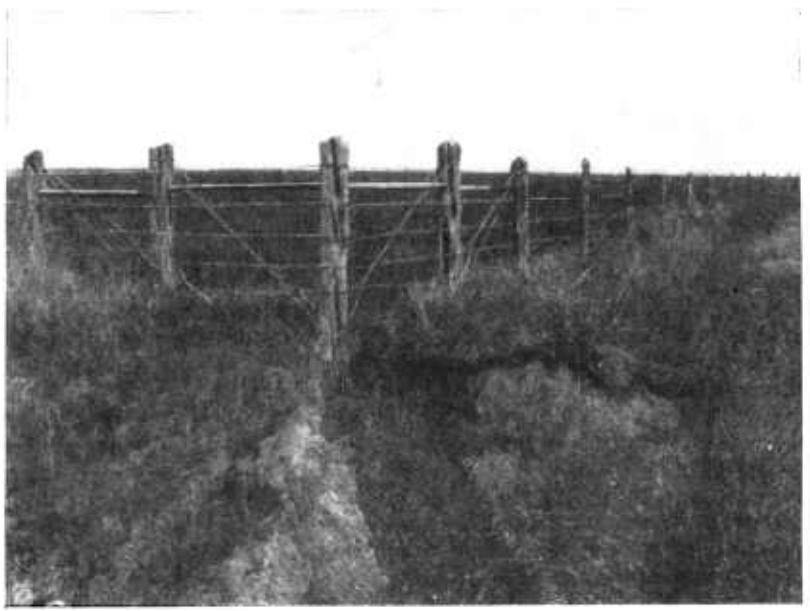


FIGURE 31.—Corner post of cedar with pipe struts.

for steel posts and consists of pipes or angle irons. Other forms for steel posts are shown in figures 9 and 35. Cedar posts such as are shown in figure 31 when well-braced should last for years.

Figure 25 shows the use of an inexpensive turnbuckle, which is an improvement over a twisted wire and permits adjustment of the tie when necessary.

POST ANCHORS

The purpose of an anchor or bearing plate is threefold; to resist strain of fence tension, impact of livestock, and frost heaving. Movement of brace posts may be resisted by use of bearing boards which press against the earth. They are placed on opposite sides of the post (fig. 29, *F*, *G*, *H*, and *I*). These boards also aid in resisting frost action and are effective as long as the bolts or spikes hold. Anchorage for the tie wires may take the form of a deadman or an improved form of buried plate (figs. 30 and 32) bearing against undisturbed soil. The latter may be used in the corner post hole, or a special hole may be dug. Plates are firmly fastened to steel posts (fig. 21) pointed so as to permit driving and deformed so as to resist pressure against

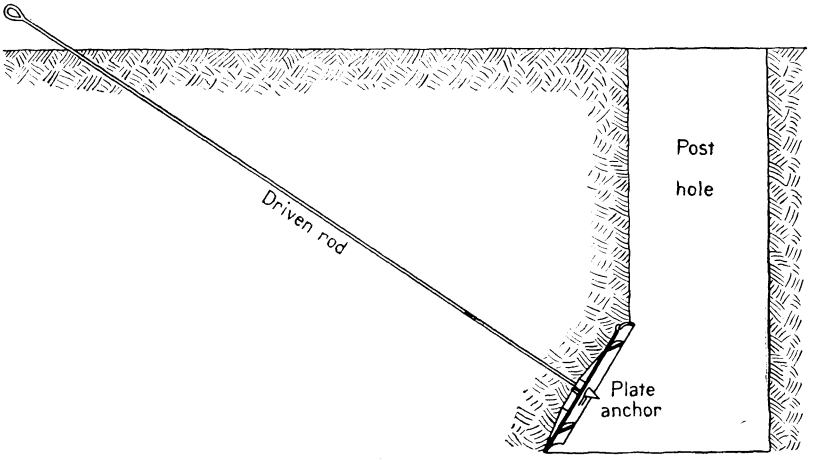


FIGURE 32.—A buried plate anchor, with a driven tie rod.

swaying or tipping. Because of the small size of steel posts, bearing plates (fig. 21) are used to resist the pressure of livestock. Figure 33 shows a firm anchor attached to the bottom end of a steel post which may be revolved and expanded so as to cut into the soil to form a base and serve as an anchor against heaving by frost. Figure 34 shows a somewhat different anchor consisting of two angle irons driven below the surface of the soil and fastened to the post by a suitable joint. Line posts are braced about every 40 rods (fig. 35). Such bracing will increase the life of the fence.

Special bracing and anchorage are required whenever fence lines depart from straight lines or on stretches (fig. 36) where there is a turning and uplifting action of a post caused by a pull from two directions. This is best resisted by a tie or brace acting in the direction of the resultant force, that is, set so as to equally divide the angle between the fences. While such a brace is sometimes in the way, it is more effective than a tie.

Posts set in low spots or valleys are sometimes weighted (figs. 37 and 38) so as to offset the uplift due to wire tension. Boards or cross

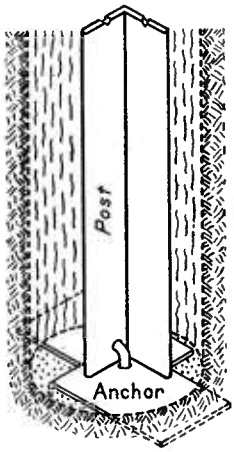


FIGURE 33.—A post anchor attached to bottom of a steel post resists frost action.

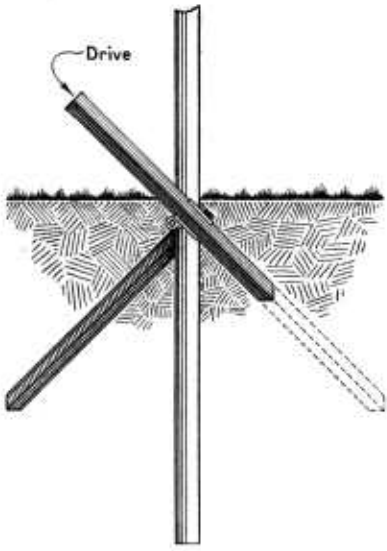


FIGURE 34.—A driven steel post anchored by steel angle irons driven into the ground.

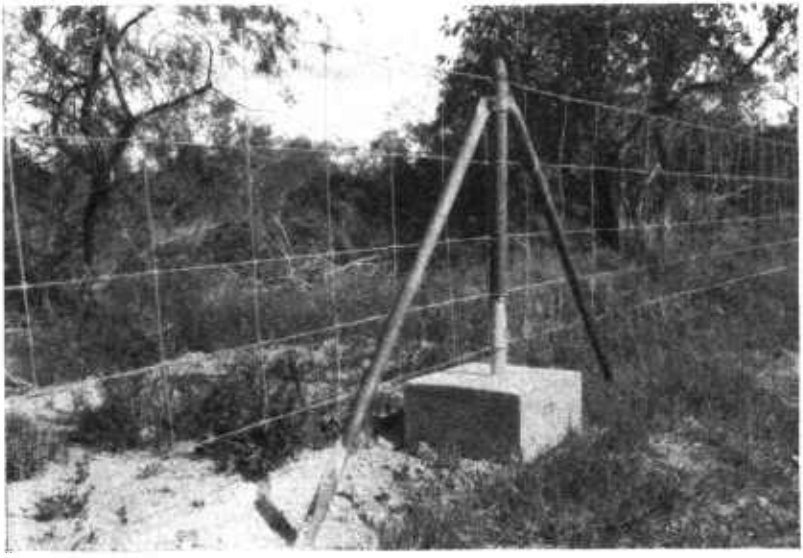


FIGURE 35.—A braced post in the fence line increases the life of a fence.

FIGURE 36.—Braces are necessary on curves.

cleats as shown in figure 29, H, or posts anchored in concrete are also used.

SPLICING

The open loop should not be used in splicing a wire as the square corners formed tend to cut, causing the wire to break more readily. The splice called Western Union has been found most lasting after years of service (fig. 39). Such a splice can be made easily with the tool shown in figure 40, *A*. When the stays are 12 inches apart there is usually sufficient wire available to make a good splice between stays, but with stays 6 inches or less apart less wire is available, and the form shown in figure 39 is used.

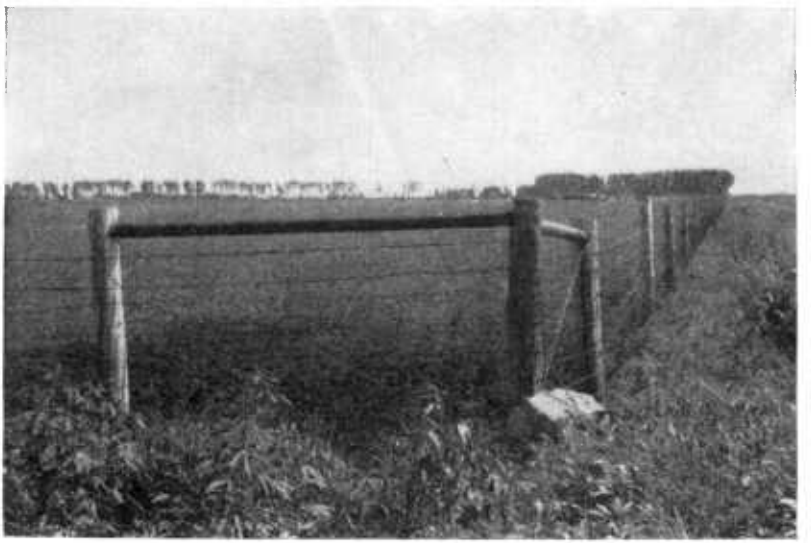


FIGURE 37.—A weighted corner post in a low, soft spot.

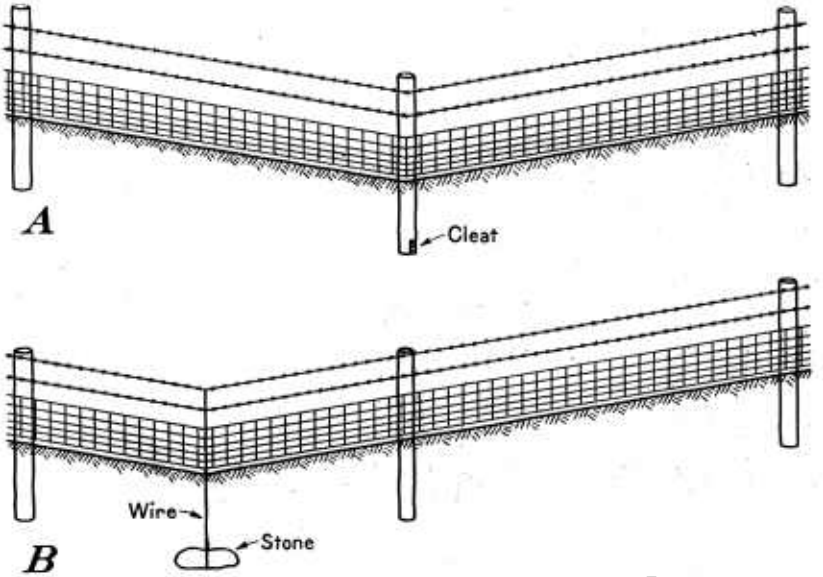


FIGURE 38.—Setting posts in depression. *A*, use of cleat; *B*, stone or other heavy anchor.

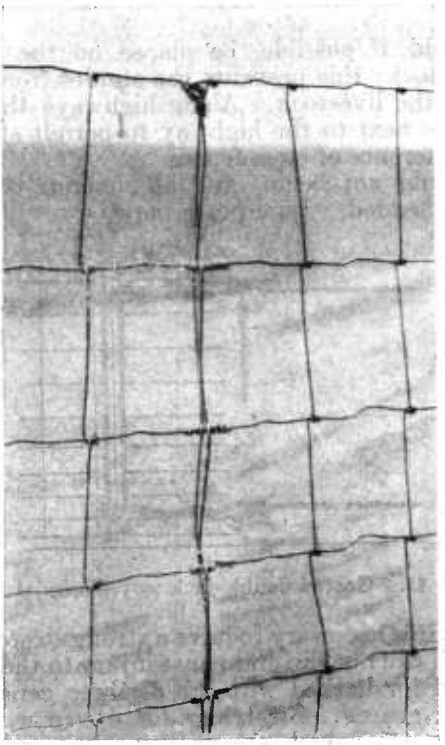


FIGURE 39.—The Western Union splice, suitable for woven wire, is easily made with splicing tool.

UNROLLING AND STRETCHING WOVEN-WIRE FENCE

The first step is to partially unroll enough fence to fasten to the corner or starting post. Fasten the ends of the wires around the post and tie them firmly, being careful to get the stay wires vertical. Unroll the fence, keeping the bottom wire close to the post and the inner side of the roll next to the post, so that the wire will cling to the post when stretched.

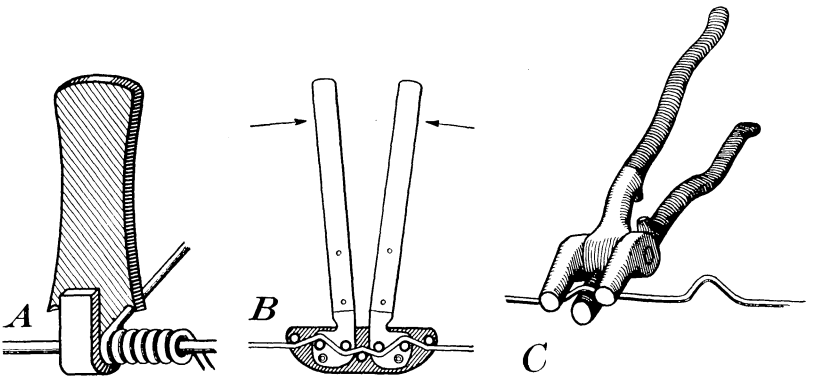


FIGURE 40.—Convenient fence tools: *A*, Splicing tool; *B*, a double-crimp tool; and *C*, a single-crimp tool.

The wire should, if possible, be placed on the side of the posts next to the livestock; this prevents the staples from being pulled by the crowding of the livestock. Along highways the wire is usually nailed on the side next to the highway to permit stretching the wire without the interference of cross fences.

Stretching should not begin until all concrete is properly set and the posts firmly bedded. Line posts may be set after the fence has

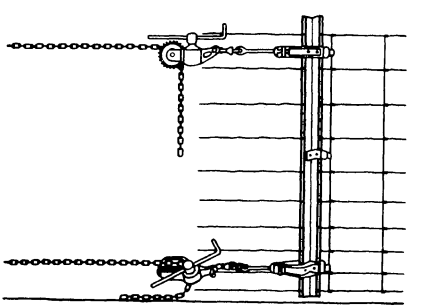


FIGURE 41.—Geared double-jack woven-wire stretcher.

been stretched. It is necessary to have a strong stretcher with dependable clamps which will not slip and cause injury to the wire or operator.

Stretchers used for barbed wire are of three general types—block and fall, lever, or geared. Stretchers for woven wire may have one or two jacks (fig. 41), which are anchored to a convenient tree or temporary post set for the purpose. Figure 42 shows a fence being stretched with a single-jack stretcher. The single jack is satisfactory

for narrow fencing such as ordinary hog wire, but two should be used for greater widths.

In fastening end wires to corner posts and gateposts, pipe or bars drawn taut by means of bolts are often used (figs. 24 and 25). These also provide a means for releasing or tightening wire tension according to seasonal demand, which is important in some sections. Using turnbuckles (fig. 25) is a novel feature in tightening brace wire and is said by the Oklahoma Agricultural Experiment Station to be well worth while. In removing slack from fence lines the crimpers shown in figure 40, *B* and *C*, are important new tools aiding in maintenance of fence lines.

Wires should not be fastened directly to trees. If a tree is in a fence line, spikes may be driven into the tree and the fence wired to these, or a strip 2 inches thick may be nailed to the trunk and the fence fastened to this.

FIGURE 42.—Stretching the fence with a single-jack stretcher.

After the fence has been unrolled the clamp bar of the stretcher should be firmly anchored to the fence. Secure the bar in a vertical position parallel to the stays and at a distance from the corner post which will permit the cutting and tying of wires around the post. An equal number of wires should be placed above and below the jack so as to obtain an even pull. Attach the chain to the pull post which has been previously set (fig. 42). Check the fence line to remove any snags and continue the stretching until the proper tension is obtained, which is when the curvature of the tension loops has been reduced about one-half. Stretch the line tightly but do not pull out the tension curves. Fences are more often understretched than overstretched.

The fence may now be fastened firmly to the anchor post, if the fence is being built on an even terrain; otherwise it will be necessary to attach it to the line posts and intermediate anchor posts at the controlling points, such as hills and valleys, as illustrated in figure

38. In this case it will be necessary to release the strain on the stretcher as additional length of fence is required.

The top wire is then cut and tied around the corner post and made taut with a single wire or end stretcher; the bottom wire and other line wires are then fastened in order.

Do not stretch the wire around a corner, but cut and tie at all angles sharper than 45°. A good pair of wire cutters or pliers are essential. Special fence pliers in one of several forms may be obtained and are very convenient (fig. 43). Ordinarily not more than one roll, or 40 rods, is stretched at one time, and the brace posts are set up at these points. Somewhat more skill is required to stretch longer lines, but lines up to one-half mile have been successfully handled. Anchor posts and some labor and time in traveling back and forth may be saved by stretching between the ends of two rolls after the fencing has been properly lined up, leaving sufficient wire in the center to properly splice the rolls (p. 41).

The woven wire is then fastened to each line post and the barbed wire unrolled and stretched. When two or more lines are to be used,

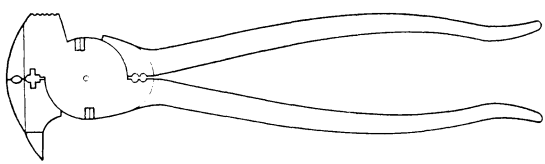


FIGURE 43.—A combination tool handy for fencing, consisting of a plier, staple puller, wire cutter, splicer, and emergency hammer.

a reel or sled is convenient for unrolling two wires at a time. A cart may be easier to move about, but the sled is somewhat safer to handle.

LIGHTNING PROTECTION

Many cattle are killed by lightning carried along a fence. In areas subjected to frequent thunderstorms it is an excellent practice to ground the fence line about every 40 rods, particularly in fence corners, where cattle are inclined to collect. Grounding a wire fence in the vicinity of high-voltage power lines is a safety precaution that should not be neglected. When steel posts are used, the fence is automatically grounded. The best way to ground a fence on wood posts is to insert steel posts or pipes at intervals along a line. The single wire sometimes stapled vertically to the post is short-lived and generally useless as a lightning conductor.

GATES AND ENTRANCES

The location of the gate is of more importance than its construction, since it must be convenient to fields or barn lot, and safe if next to a highway. The choice of a gate and its construction depend upon its use.

The entrance to a roadway must be well-drained to prevent erosion and to permit all-weather use; approaches should have an inner radius of not less than 30 feet and up to 40 feet where tractor and trailer are used. Square turns with a small turning space may be satisfac-

tory for horse-drawn vehicles, but easy curves are required for motor vehicles (fig. 44). Driving straight ahead is preferable to backing and turning.

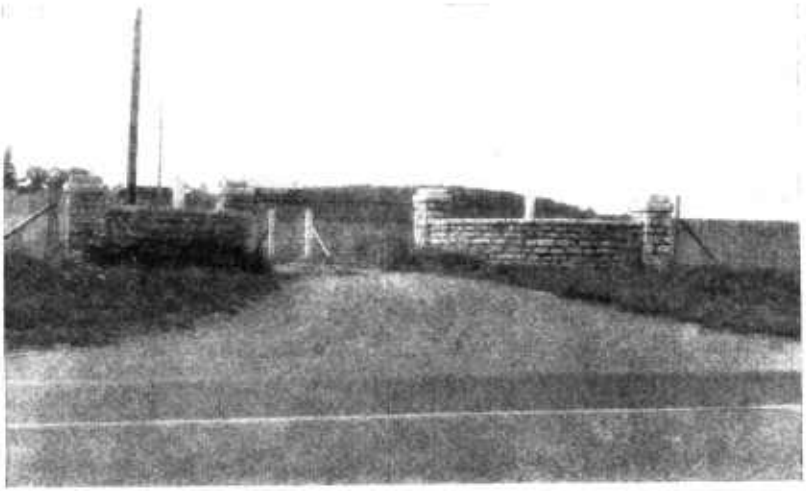


FIGURE 44.—An attractive farm entrance 30 feet or more from the highway.

FIGURE 45.—A hidden farm entrance is dangerous to farmer and traveler.

The importance of a safe entrance off a main highway increases as the speed of travel on highways increases. Figure 45 shows a dangerous farm entrance since the highway is hidden from the driver's view by trees. A slow-moving vehicle or farm implement in coming out of such an entrance may block the highway and endanger both farmer

and motorist. Figure 46 shows an improved field entrance with an offset extending inward beyond the main fence line. Such an offset must extend at least 20 feet back from the highway to provide for all implements likely to be used. A level entrance or one on a gentle slope is less trying on the brakes and far safer than one located on a hillside.

Culverts may be built large enough for use as cattle underpasses. If built solely as a cattle pass they are necessarily expensive but may be justified for registered stock. Whether a lane is advantageous depends upon its cost, the saving of labor, and needed protection of livestock. The shape of the farm and position of fields also must be considered. The width of pasture lanes may vary from 20 to 50 feet. Loss of crop acreage, value of land, amount of livestock and the need for such a lane will determine the proper width. Lanes less than a

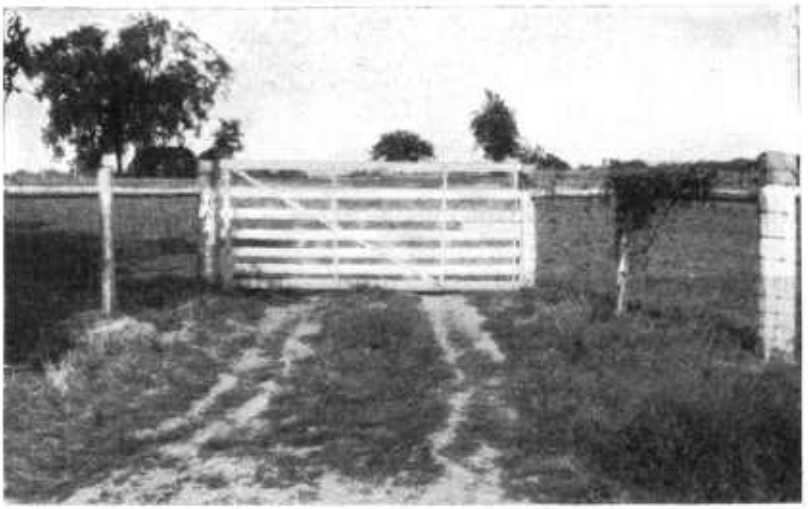


FIGURE 46.—The gate set back about 20 feet from fence line adds to the safety of the entrance to field and pasture.

rod wide are difficult to keep in grass where used regularly by several head of stock.

Figure 47 shows how stock may be safeguarded from traffic by means of a lane parallel to the highway.

A pleasing entrance adds much to the attractiveness of a farmstead. A well-designed entrance can do much to advertise the farm and farm products. Figures 44 and 59 illustrate these possibilities. Stone, brick, and concrete, either separately or in combination, can be used. The choice of design depends in part upon availability of material and labor.

The cheapest form of wire gate (fig. 48) is made of three or four strands of wire fastened to a wood or steel bar and held by loops of wire at the gatepost. In a timbered section pole gates (fig. 49) may be economically used for fields entered infrequently. The sliding form of simple board gate is cheap and may be used for cultivated fields (fig. 50). Entrances to farmstead and barn lots are much used and should have gates that are substantial and easy to operate.

FIGURE 47.—A lane from the barnyard to the spring.

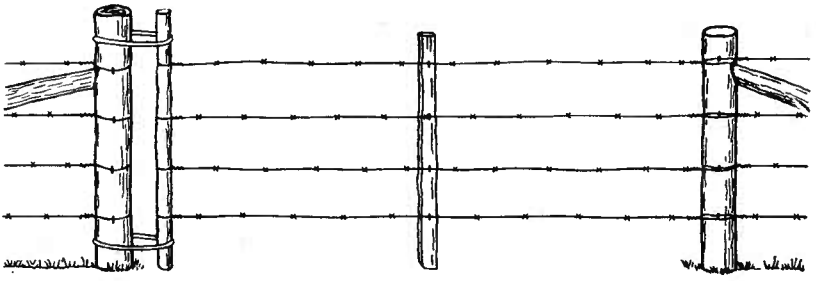


FIGURE 48.—A simple wire gate.

FIGURE 49.—A simple pole gate for an isolated pasture.

Driveway and entrance gate, may be had in several forms, wood or steel, plain or ornamental. The ordinary farm entrance gate is usually a swinging gate and may swing either or both ways.

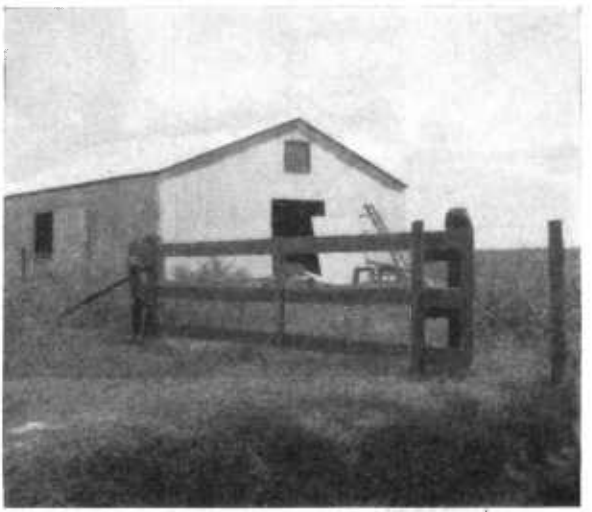


FIGURE 50.—A cheap three-board sliding gate operated without hinges.

A gate that drags on the ground is difficult to operate. A few hours of labor spent in the construction and proper hanging of a gate will save time and much aggravation.

FIGURE 51.—A good farm gate hung on strong hinges.

The width of the gate will vary with its use, the size of the herd, and the kind and width of implements to be passed. The common widths are 8, 10, 12, 14, and 16 feet. The minimum track width is usually 8 feet; turning and entering at the same time calls for greater

width and a radius not less than 30 feet. Binders and combines or loaded hay wagons require widths from 14 to 16 feet for convenient entrance. Gates from feed lots, etc., usually close from the lot side, while entrance gates to farmsteads should swing both ways. A single swinging gate (fig. 51) is more convenient to operate than a double gate.

Lightweight gates increase the ease of operation, but gates of too light construction are easily broken by stock crowding against them or by being struck by automobiles or trucks. Figure 52 illustrates a substantial gate guarding an entrance through which large herds must pass. The planks on the fence adjacent to the gate lessen the risk of damage.

The common heights of farm gates are 48, 50, and 55 inches. Steel gates often weigh less than 100 pounds; wood gates may weigh 200 pounds or more.

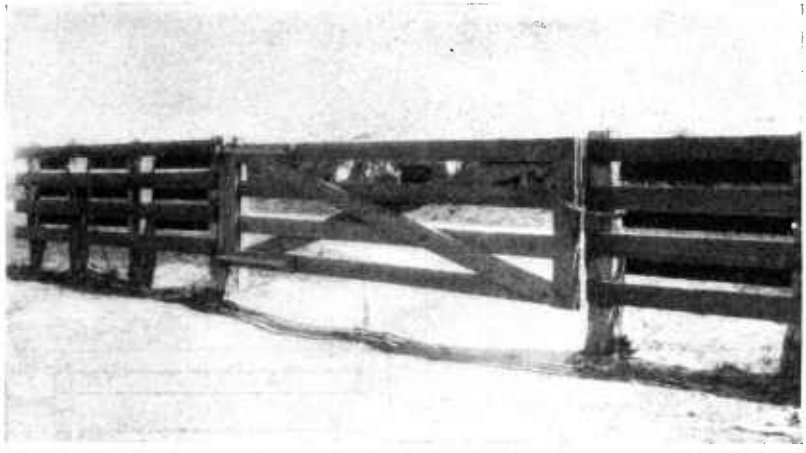


FIGURE 52.—A substantial ranch gate with reinforced gateposts.

BRACING GATES

The object of bracing is to prevent the sagging and racking of the gate. Bolts and well clinched cut nails should be used. Rods or wire may be used to prevent racking or to support the weight of the gate as shown in figure 53. A well-braced gate is easy to operate and is durable. Many braces are poorly placed, and the strength added is entirely dependent upon the resistance to slippage of bolts and nails. The efficient brace for a gate is a prop (fig. 54), and it gains strength by the stiffness of this member as well as firmness of anchorage by bolts and nails. The cross braces in figures 52 and 53 decrease racking and add stiffness to resist shock from livestock.

With steel gates distortion may be prevented by using adjustable wire ties or rods as in figure 55, *A* and *B*. Using steel rods gives a more positive grip of hinges and makes the gate lighter.

Yard and paddock gates must be substantial to withstand frequent shocks from livestock confined in small enclosures (fig. 52). Some convenient forms for use under different circumstances are shown in figures 48, 51, and 56.

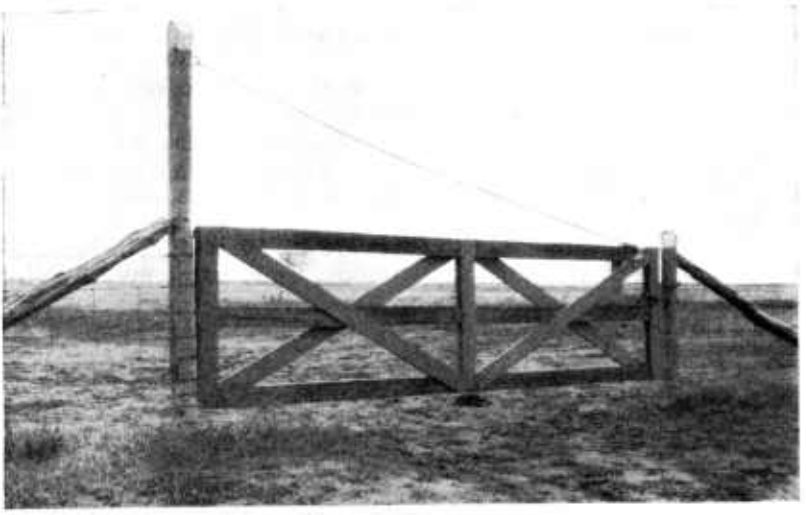


FIGURE 53.—A 16-foot gate supported by a rod. This type of gate needs a well-set gatepost.

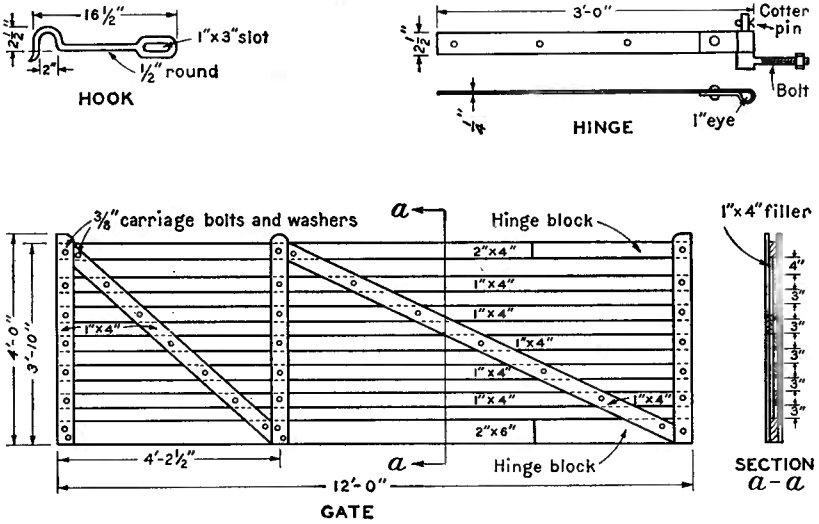


FIGURE 54.—Detailed plan of gate.

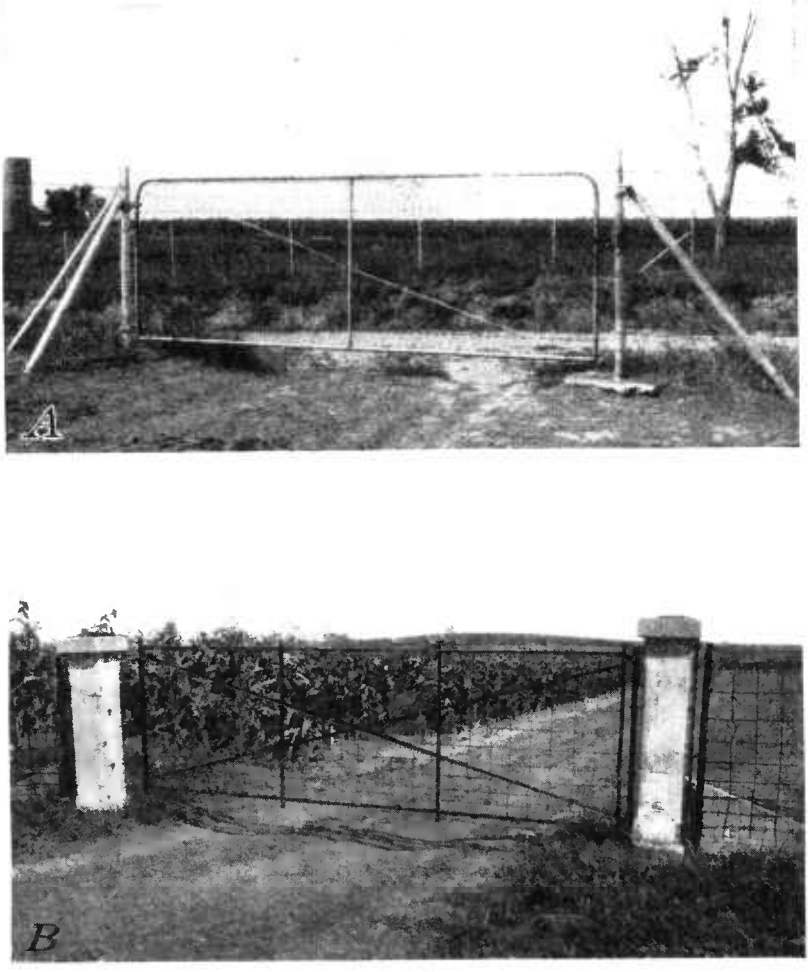


FIGURE 55.—Two forms of steel gates: *A*, A light gate of pipe frame and diamond-mesh wire with wire tie; *B*, a steel gate of angle iron and woven wire—cross ties and stays of light angle iron.

CATTLE GUARDS AND AUTOMATIC GATES

Cattle guards and automatic gates are very handy for use with automobiles and trucks. Cattle guards, as shown in figures 57 and

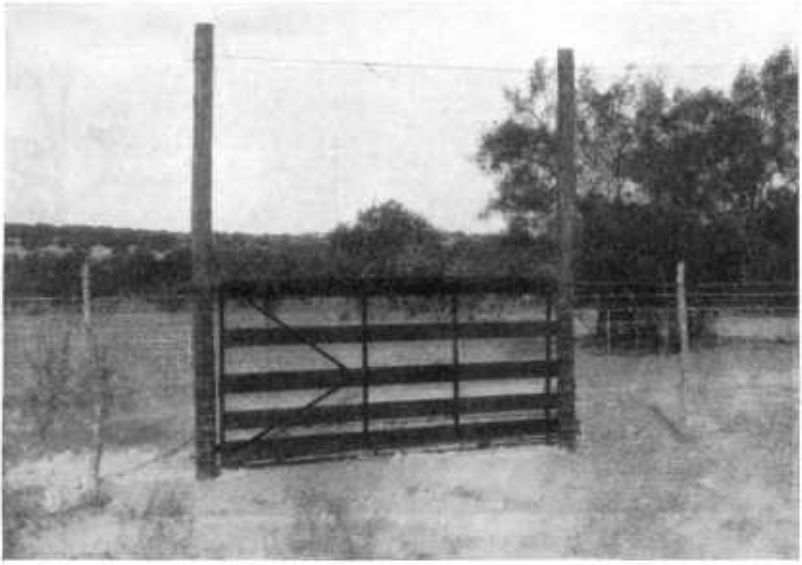


FIGURE 56.—A simple board gate with angle-iron braces and overhead wire ties for gateposts.

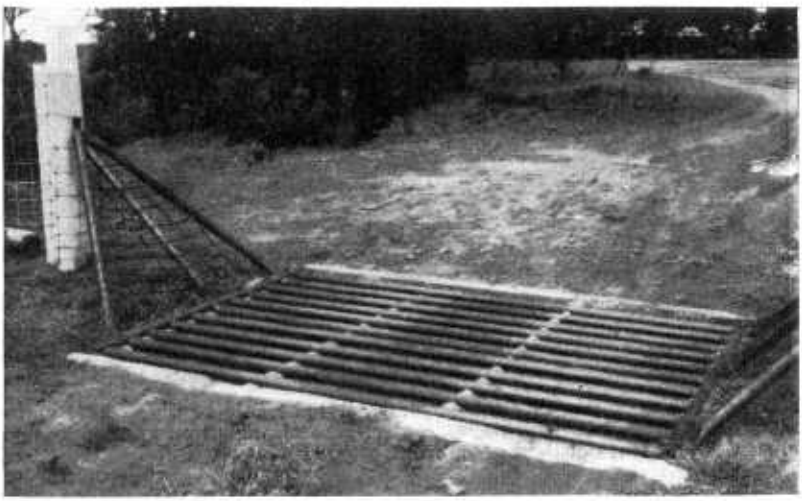


FIGURE 57.—A cattle guard of iron pipe. The pipes may be removed for cleaning. Wire guards are sufficient for sheep and goats.

58, are very useful for automobiles and may be built strong enough for trucks by using discarded steel rails or small I-beams. Pipes vary from 1½ to 2 inches in diameter and are spaced from 6 to 9 inches center to center. Too-wide spacing causes severe jolting and may

bring about damage to the supports from loaded trucks. The grated area is from 4 to 6 feet wide and forms an effective barrier for

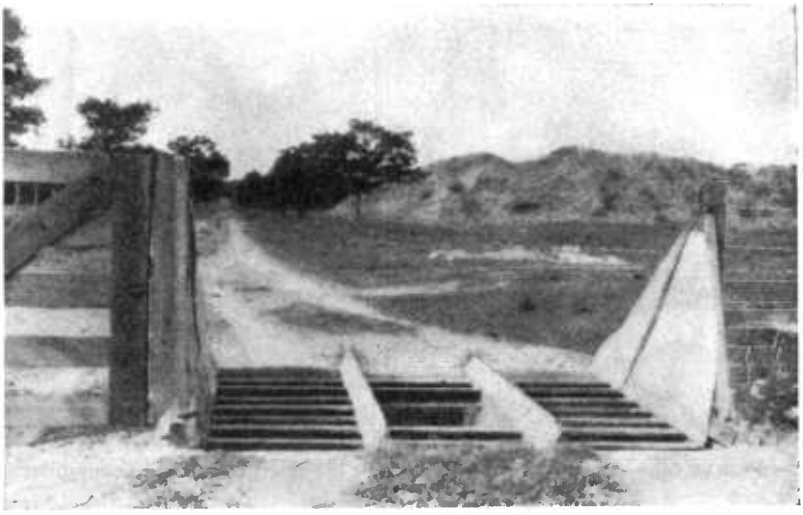


FIGURE 58.—A goatproof cattle guard with metal shields. The central opening permits cleaning and discourages goats and sheep from crossing.

the larger livestock. Goats and sheep will walk through if a smooth path 2 inches or more in width is provided. They are effectively restricted by wire or metal wings, as shown in figures 57 and 58.

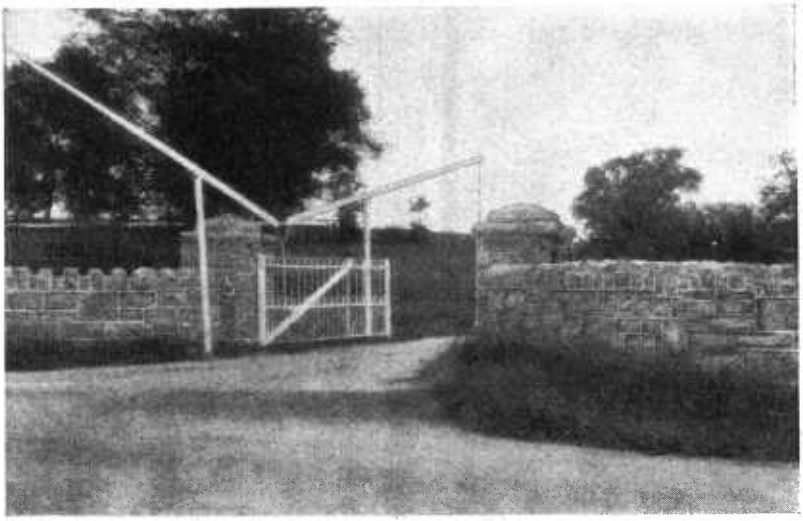


FIGURE 59.—An attractive entrance with an automatic swinging gate which is easily operated from an automobile by a pull rod.

The open central space (fig. 58) and the V-shaped covering on the timbers are further obstacles respected by goats. The pit 12 to 18 inches below the grate or bars is part of the guard. The question of

the drainage of this pit is important. If mosquitos or weeds become troublesome, kerosene, crankcase oil, or chemicals may be used. The

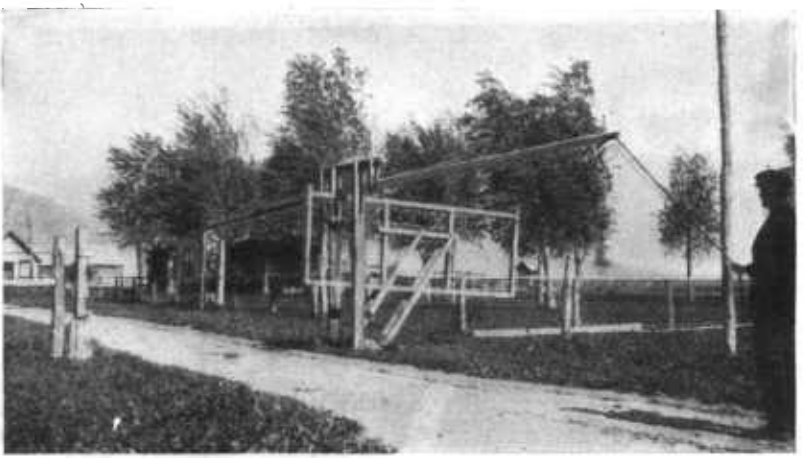


FIGURE 60.—An automatic sliding gate operated from the automobile.

bars should be removable so that the pit may be cleaned occasionally. Where pits are too objectionable a raised ramp may be used, but a level ramp is usually preferred.

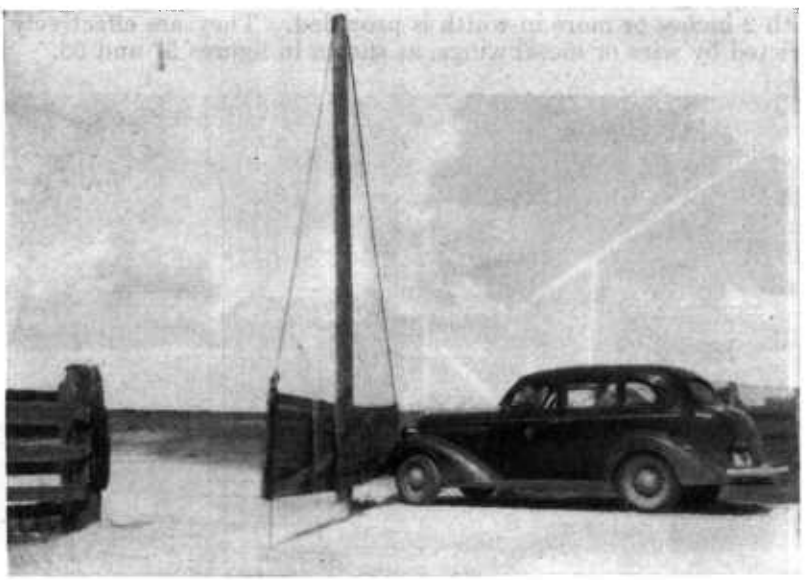


FIGURE 61.—A bumper gate partially open; it may be locked open for the free passage of cattle or trucks. The gate swings from a chain or cable and closes by gravity.

Automatic gates for automobiles or other vehicles are made in three forms—swinging, tilting, and sliding. They may be operated by a pull rod, as shown in figures 59 and 60, or by a lever or cam operated

by a car or truck. The bumper or swinging gate shown in figure 61 may be pushed open by cars. Any form of vehicle or livestock may pass through this gate when open, whereas a second gate is necessary when the cattle-guard form (fig. 58) is used. Such gates swing from a central support of chains or cable and are very convenient under some conditions, but fenders, door handles, and truck bodies as well as the gate may suffer damage when the gate is carelessly or unskillfully operated.

The balanced or weighted gate offers some advantages since it is easily operated and less substantial gateposts may be used. An early form used a rock weight on an extended arm of the top rail of the gate. Figure 62 shows an improved modern form, which is balanced and is adjustable with respect to height. This permits the passage of small livestock underneath or its use over snowdrifts.

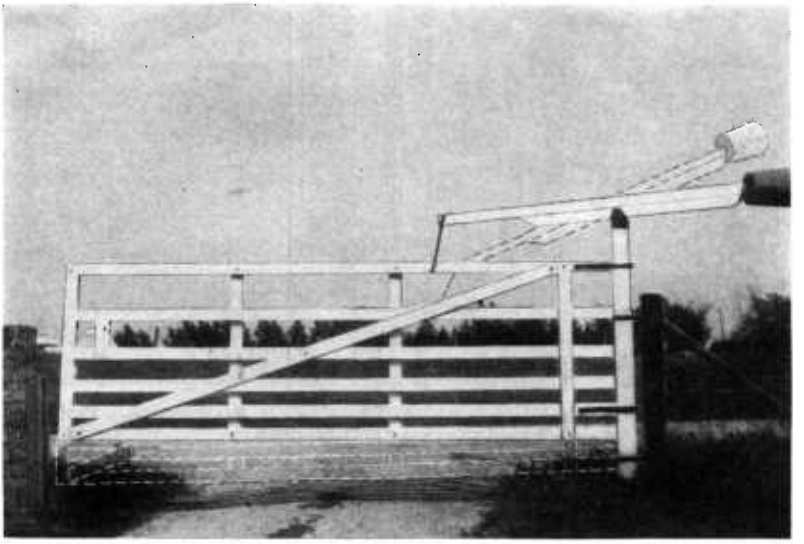


FIGURE 62.—A balanced gate adjustable as to height shown in raised position. Dotted lines show the position of the gate and weight when lowered.

GATEPOSTS AND HARDWARE

Gateposts should be substantial, usually not less than 10 or 12 inches in diameter and should be set in the ground at least 4 feet and firmly anchored. Gateposts that creep and spread apart cause much difficulty with gate latches. Frost action, gate weight, and fence tension all combine to produce movement of gateposts. Gateposts may be permanently tied together, as in figure 56, to prevent creeping. When gateposts are set they should, at least temporarily, be tied together and so held until firmly tamped or set. The chain used in figure 63 insures a safe lock and permits the use of a padlock when desired. Large snaps made with rust-resistant bolts in place of padlocks are sometimes used.

The use of lag screws for hinge anchors is unsatisfactory, particularly with heavy gates. Water causes rotting and weakening of the wood, permitting the screws to pull out. Hook bolts extending through the post are more satisfactory. Unauthorized entrance by lifting the

gate from its hinges may be prevented by turning the top hook down. The strap hinges shown in figure 52 are extra long, and all sharp edges are flattened and beveled so as to avoid injury to livestock. The simple hook shown in figure 54 may be used when the gate opens one way. In many cases a gate latch in the form of a hook and bolt may be made to support the outer end of the gate and thus reduce the strain on gateposts. A supporting block under the corner of the gate may also be used.

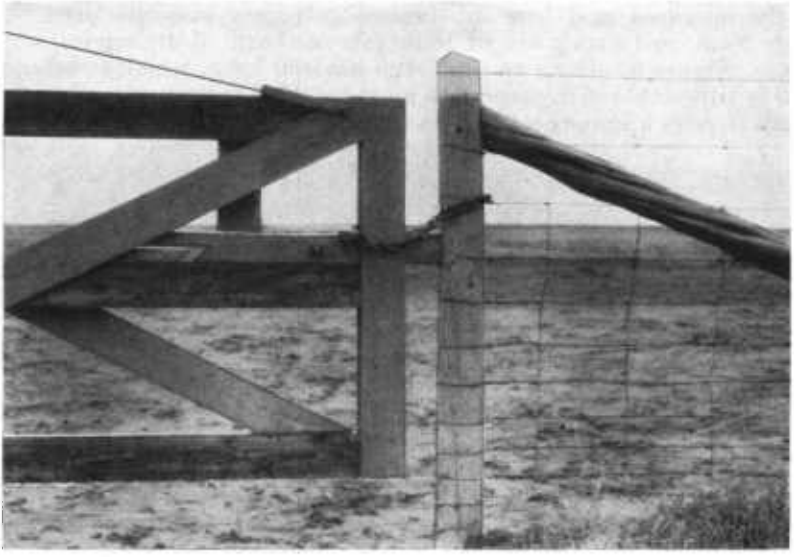


FIGURE 63.—A sliding gate latch notched to make it stock proof. Padlock and chain prevent theft of stock.

MAINTENANCE OF FENCES

Maintenance is an important item to consider in choosing a fence for a given condition. The total cost of fencing includes interest, repairs, depreciation, interest on the land occupied by the fence row, and the cost of cleaning fence rows and keeping down weeds. Cheap materials and cheap construction lead to high cost of maintenance and a short-lived fence. Annual depreciation of fences lasting 20 years is only 5 percent, whereas if the life of the fence is 15 years the depreciation is 6.6 percent. In permanent fences good grades of material and good workmanship are cheapest in the long run. Studies made in the Northeastern States and the Corn Belt reveal that the annual cost of maintenance may vary from 4 to 6 cents per rod of wire fencing, or from about 50 to 60 cents an acre. These data represent approximate averages and may be widely altered by specific conditions.

Spring and fall are the most favorable seasons to inspect fences, drive down posts heaved by winter frosts, repair, relocate, or abolish fences. In moving a fence line the removal and re-use of the wire or disposal is often a problem. Old barbed wire may be rolled on old barrels. Wire that is unsatisfactory for re-use may be placed in ditches or fastened to stakes to decrease soil erosion, but in any case should not be left in fence corners or any place where it may be a menace to livestock.

The re-use of fence posts in relocating fences is often determined by the difficulty of removing sound posts. Post pullers may be pur-

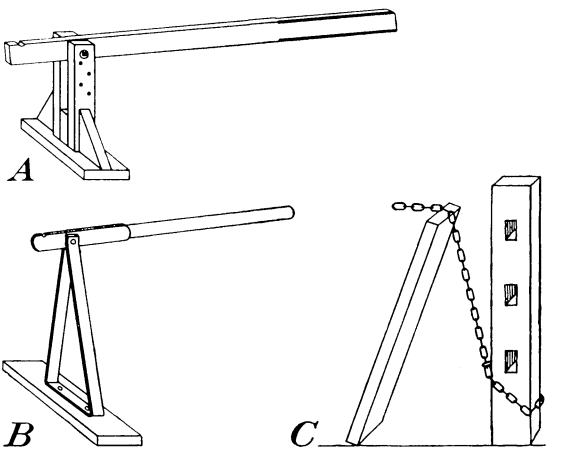


FIGURE 64.—Suggestions for pulling fence posts: *A*, A home-made wood-frame post puller; *B*, a steel form of puller; *C*, a form for pulling a post with a team or tractor.

chased, or a puller similar to figure 64 may be made. A tractor or a team of horses with a chain and pole is often useful.

Along highways the soil sometimes erodes and slides into the ditch, making it necessary to shift the fence line. The cooperation of the highway authorities in sodding or planting vines or shrubs to reduce soil washing will aid in such cases. The use of tile in place of ditches is also helpful. In other cases there appears to be little help outside of moving the fence back from the property line.

It is always helpful to have the highway fence lines seeded to grass or hay crops which keep down weeds and can be mowed easily. Road engineers now pay more attention to leaving banks so that they may be taken care of easily. Careless smokers often start fires which cause heavy losses of fences and crops. Many farmers plow a strip several furrows wide along the fence line as a fireguard.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	HENRY A. WALLACE.
Under Secretary	M. L. WILSON.
Assistant Secretary	HARRY L. BROWN.
Director of Information	M. S. EISENHOWER.
Director of Extension Work	C. W. WARBURTON.
Director of Finance	W. A. JUMP.
Director of Personnel	ROY F. HENDRICKSON.
Director of Research	JAMES T. JARDINE.
Director of Marketing and Regulatory Work	A. G. BLACK.
Solicitor	MASTIN G. WHITE.
Land Use Coordinator	M. S. EISENHOWER.
Office of Plant and Operations	ARTHUR B. THATCHER, *Chief.*
Office of C. C. C. Activities	FRED W. MORRELL, *Chief*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Office of Foreign Agricultural Relations	LESLIE A. WHEELER, *Director.*
Agricultural Adjustment Administration	R. M. EVANS, *Administrator.*
Bureau of Agricultural Chemistry and Engineering.	HENRY G. KNIGHT, *Chief.*
Bureau of Agricultural Economics	H. R. TOLLEY, *Chief.*
Agricultural Marketing Service	C. W. KITCHEN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Commodity Credit Corporation	CARL B. ROBBINS, *President.*
Commodity Exchange Administration	J. W. T. DUVEL, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Entomology and Plant Quarantine	LEE A. STRONG, *Chief.*
Farm Security Administration	W. W. ALEXANDER, *Administrator.*
Federal Crop Insurance Corporation	LEROY K. SMITH, *Manager.*
Federal Surplus Commodities Corporation	MILO R. PERKINS, *President.*
Food and Drug Administration	WALTER G. CAMPBELL, *Chief.*
Forest Service	FERDINAND A. SILCOX, *Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
Division of Marketing and Marketing Agreements.	MILO R. PERKINS, *In Charge.*
Bureau of Plant Industry	E. C. AUCHTER, *Chief.*
Rural Electrification Administration	HARRY SLATTERY, *Administrator.*
Soil Conservation Service	H. H. BENNETT, *Chief.*
Sugar Division	JOSHUA BERNHARDT, *Chief.*
Weather Bureau	FRANCIS W. REICHELDERFER, *Chief.*

This circular is a contribution from

Bureau of Agricultural Chemistry and Engineering.	HENRY G. KNIGHT, *Chief,*
Division of Farm Structures Research	WALLACE ASHBY, *Chief.*

U. S. GOVERNMENT PRINTING OFFICE: 1940

For sale by the Superintendent of Documents, Washington, D. C. - - - - - Price 10 cents